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MANPOWER UTILIZATION AND FUTURE NEEDS OF MANUFACTURING INDUSTRIES IN WATER POLLUTION CONTROL

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CHAPTER I

INTRODUCTION

A plentiful and readily available supply of water is essential to economic and social progress. As the production of goods and the introduction of new products have continued to increase, a phenomenal increase in water use by industry h. s occurred. Water use by industry has increased twenty fold since 1900. Approximately 3 trillion gallons per day, or about seven times the average daily discharge of the Mississippi River, are used by industry (Geological Survey, 1972). Electric power generation accounts for 80 percent of water usage by industry. Excluding the large demand of the hydroelectric industry, industry still withdraws water at an average rate of 220 billion gallons per day, or approximately one-half the average flow of the Mississippi River at Vicksburg, Mississippi.

The gross amount of water used by industry far exeeds the quantity withdrawn because much of the water is recycled and reused in the manufacturing process. Only six percent of the water withdrawn by industry is consumed by evaporation or incorporated into products. The remaining 94 percent is returned to receiving streams for reuse by industries and towns downstream. Much of this returned water has been degraded considerably and has resulted in the necessity for more and better treatment of these waters before they are discharged.

Various kinds of pollution are caused by inadequately treated industrial wastewaters. Organic wastes, insoluble particles, and thermal pollution are discharged by a wide variety of industries. Under new State and Federal pollution control legislation standards have been established which will make it necessary for industry to improve their wastewater treatment facilities.

One of the most complex problems resulting from this necessity to improve wastewater treatment systems is the assessment of the manpower that will be required to operate and maintain these systems. Approximately 240,000 industrial concerns are discharging approximately 16 trillion gallons of wastewater each year into our streams, lakes, and estuaries--a volume rivaled only by the domestic household waste discharge. Although not all of this discharge is adding foreign polluting substances to the waterways, a significant proportion does so and contributes tremendous heat loads to the environment. Eighty-five percent of the annual wastewater discharge is attributable to four major industry groups:

- Primary metal industries
- Chemical and allied products
- Paper and allied products
- Petroleum and coal products

The discharge of wastewater from manufacturing facilities is highly concentrated. Approximately 60 percent of the industrial discharges are located in five regions: The Delaware and Hudson River basins; the Ohio River; the Eastern Great Lakes; the Western Great Lakes; and the Western Gulf of Mexico. Establishments with an annual withdrawal of 20 million gallons or more of water account for about 97 percent of water withdrawn for manufacturing purposes. However, these organizations represent only 4 percent--approximately 10,000 establishments--of the total number of manufacturing establishments and employ approximately 45 percent of all U.S. manufacturing workers.

Water pollution control activities in industry consist largely of the establishment and operation of internal wastewater treatment plants, either to provide preliminary treatment of toxic wastes before effluent is released into municipal sewage collection systems or to treat the effluent completely before its ultimate discharge into the waterways. Personnel engaged for water pollution control functions consist predominantly of plant operators and technicians, although professional personnel are used in ever-increasing numbers in treatment process selection, plant design, supervision of operations and maintenance, analysis of industrial effluents to establish treatment requirements, and coordination with municipal utilities to negotiate pretreatment processes and municipal treatment charges for wastewaters discharged into municipal sewer systems.

CHAPTER II

SOURCES OF DATA

A combination of data presented in the 1968 Census of Water Use in Manufacturing (Bureau of the Census) for those industries utilizing at least 20 million gallons of water per year, data collected by EPA in a poll of 10,000 industries to determine their projected professional, and technical manpower and training requirements and data presented in a report by Environmental Science Services Corporation were used to develop the total numbers of personnel in various industry categories working on water pollution control.

Occupational categories used by EPA to classify personnel employed in industrial wastewater treatment plants in the poll of 10,000 industries are shown in Table 1. These classifications are similar to those used to classify personnel at municipal wastewater treatment plants. Table 2 shows the occupational categories and educational requirements found at several existing industrial wastewater treatment plants by the Environmental Science Services Corporation (ESSC). Again, these classifications do not differ significantly with municipal classification nor do they differ significantly with the EPA classification. Although these classifications are similar, the individual systems employed must be kept in mind when comparing or evaluating the estimates of manpower based on either system.

Table 1. Occupational categories used by the EPA to classify personnel employed in industrial wastewater treatment plants (Environmental Protection Agency, 1971).

A. Superintendent - Responsible to plant manager for supervision of water pollution control function. Deals with government agencies on waste discharge and water quality problems. Oversees design, operation, maintenance and administrative activities associated with wastewater treatment facilities.

B. Engineer - Designs and/or supervises construction, operation or maintenance activities. Analyzes problems caused in treatment and disposal of wastewaters; formulates processes or recommendations for alleviation of detrimental conditions.

Sanitary Engineer - Same as Engineer but requires skills and knowledge that can best be obtained through a degree in sanitary engineering.

C. Chemist - Performs qualitative and quantitative chemical or physical analyses of process waters to determine composition and properties. Provides technical advice within his speciality for supervisory or other management engineering personnel. Assists in special problems, development of test and process methods, improves procedures for quality control of tests and their interpretation. May supervise Laboratory Technicians.

D. Microbiologist - Performs laboratory analyses to determine the presence and concentration of certain microorganisms. May perform direct microscopic examinations or other special tests for evaluation of microbiological problems in wastewater treatment processes. Within his area of specialization, provides technical advice to engineers, chemists, and others concerning interpreation of microbiological and bacteriological data and observations and the handling of related problems. May supervise Laboratory Technicians.

E. Laboratory Technician - Performs qualitative and quantitative tests of a physical, chemical, or bacteriological nature. Tests are made on process waters according to prescribed procedures as designated by his supervisors.

F. Senior Operator-Foreman (nonengineer) - Supervises and coordinates activities of workers in operation and maintenance of various elements of wastewater collection and treatment facilities.

Table 1. Continued.

G. Operator - Works with minimum supervision. Starts, stops and adjusts flows on the basis of his interpretation of instrument readings and tests results. May perform operational control tests. Performs or oversees preventive and breakdown maintenance. Gives direction to attendants and unskilled workers.

H. Instrument Repairman - Installs, repairs, maintains, and adjusts indicating recording, telemetering and controlling instruments and analytical instruments of wastewater treatment facilities.

I. Maintenance Man - Skilled mechanic (includes general mechanics, plumbers, electricians, pipefitters, machinists, etc.) who repairs and maintains machinery, plumbing, physical structure, electrical wiring, motors, and other components of waste collection and treatment systems.

J. Attendant - Operates designated equipment according to specific instructions. Starts, stops and adjusts flows and equipment in line with precise instructions. Performs routine maintenance tasks, e.g., cleaning and lubrication. May keep log of instrument readings.

K. Unskilled - Performs any combination of unskilled tasks, usually under continuous supervision. Removes waste material, cleans equipment or facilities. He may perform operating or maintenance tasks under direct supervision of more experienced personnel.

L. Other - All other employees engaged in administration, operation and maintenance of wastewater treatment and collection facilities.

Table 2. Occupational categories and educational requirements used by Environmental Science Services Corporation to classify personnel employed in industrial wastewater treatment plants (Environmental Science Services Corporation, 1968).

Area	Task Function	Definition of Task	Formal Education Required	Specialized Training Required
I. Operations	a. Unskilled	Routine operations	Less than high school	On the job
	b. Skilled	Process control; intermediate decision making	High school or more	Operator training
II. Laboratory	a. Technician	Routine analysis	High school	On the job
	b. Detailed analysis and plant control	Calculations and evaluations	College or equal	Short courses
	c. Special and auto analysis	Use of complicated analytical equipment	College	Highly specialized instrumentation courses
	d. Investigations	Plan and carry out investigations	College	Specialized training programs
III. Maintenance	a. Unskilled	Routine maintenance	Less than high school	On the job
	b. Skilled repair and replacement	Repair and replacement of complex equipment	High school plus apprentice experience	Short courses
IV. Instrument and Controls	a. Routine	Routine cleaning, reading and maintenance of instruments	High school	Special short courses

Table 2. Continued.

Area	Task Function	Definition of Task	Formal Education Required	Specialized Training Required
IV. (Cont'd.)	b. Operations and Controls	Installation and maintenance of complex instruments and controls	2-Year technical school	Special manufacfacturers' courses
V. Supervision (operations)	a. Para-professional	Shift operations foreman	High school plus	Operators training school
	b. Professional	Runs plant with broad decision making ability	College, additional specialized schools and/or masters degree	Short courses, FWPCA courses, industrial managerial and technical courses
	c. Managerial	Runs sanitary district or industrial utility department	College and specialized courses	Specialized courses

The pages of the EPA Survey form used to obtain manpower needs and wastewater discharge rates are shown in Appendix A.

Data provided in the ESSC report were obtained by personal interviews and observations at several wastewater treatment plants with various discharge flow rates that were considered typical of the respective industry being evaluated. The EPA Survey was sent to 10,000 industries in the industrial categories known to use large quantities of water in the manufacturing process. The response from the EPA Survey was rather erratic, and it is questionable as to how representative the data are of the industries sampled. Better than fifty percent response was obtained; however, the number of establishments reporting both manpower needs and wastewater discharge rates were very limited. Table 3 shows by year and industry group the number of firms reporting information on the number of employees involved in wastewater treatment and the wastewater discharge rate.

All of the manpower data collected in the EPA Survey are compiled in Volume II of this report. Over two thousand survey forms were reviewed and summarized, but because of the limited amount of useful data presented, Volume II will be reproduced in limited quantities. If these data are needed, a review copy of Volume II can be obtained, or the original survey forms can be reviewed with the consent of the EPA.

Flow diagrams of each wastewater treatment system reported in the EPA Survey were prepared in an attempt to determine some pattern

Table 3. Number of firms by industry group reporting information on the number of employees involved in wastewater treatment.

SIC Code	Industry Group	Number of Firms Reporting Employees Involved In Wastewater Treatment					
		1971	1972	1973	1974	1975	1976
20	Food & Kindred Products	134	103	87	82	80	81
22	Textile Mill Products	8	6	6	6	6	6
24	Lumber & Wood Products	2	2	2	2	2	2
26	Paper & Allied Products	23	14	13	11	10	10
28	Chemicals & Allied Products	128	110	105	104	104	104
29	Petroleum & Coal Products	9	7	5	5	5	5
30	Rubber & Plastic Products	9	7	6	6	6	6
32	Stone, Clay & Glass Products	2	2	1	1	1	1
33	Primary Metals Industry	43	35	33	30	28	26
34	Fabricated Metal Products	4	1	1	1	1	1
35	Machinery, Except Electrical	1	1	1	1	1	1
36	Electrical Equipment & Supplies	2	2	1	1	1	1
37	Transportation Equipment	6	5	1	1	1	1
38	Instruments & Related Products	1	1	1	1	1	1

in the various industry groups. It was found that all wastewater treatment systems for industries tend to fall into one of the following categories:

a. Pretreatment and Discharge to Municipal Sewer

b. Biological Treatment and Surface Discharge

c. Surface (Spray) Irrigation

d. Surface Storage and Evaporation

e. Deepwell Injection

f. Lagoon-Evaporation

g. Land Disposal

h. Surface Disposal

Manpower needs data by occupational category and year for the industries reporting wastewater treatment practices and manpower needs are summarized in Table 4 according to industry group (SIC Code), and waste abatement practices as outlined in a - h above. The sum of the least number of production employees and the sum of the wastewater discharge flow for industries falling within a particular industry group and waste abatement practice category are also presented in Table 4.

Table 4. Continued.

SIC Category (Plants Reporting)	Waste Abatement Practices	Number Plants Reporting Waste Treatment Practice	Least Number of Production Employees	Discharge Flow Gallons/Day	1971																	
					Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	
2426	Pretreatment & discharge to municipal sewer	2	100	48,000													1		1			
2611	Surface storage & evaporation	1		837,000	1	3			4		8	1	2			1		1	2			
	Pretreatment & discharge to municipal sewer	1		1,130,000	1	1			1				1					1	1			
	2611 Total	2		1,967,000	2	4			5		8	1	3			1		2	3			
2621	Pretreatment & discharge to municipal sewer	7	850	5,440,740	9	6	2		7	18	16	5	10	4		2		2	1	1		
	Surface disposal	1		4,500	1	1			1	1				1								
	Surface storage & evaporation	3		1,006,100	3	2	2		4	1	3	1	4	4		1		3	2	2		
	2621 Total	11	850	6,451,340	13	9	4		12	20	19	6	14	9		3		5	3	3		
2631	Pretreatment & discharge to municipal sewer	5	750	7,427,265	4	4	2		5	3	5	2	10		3	1		3	4	2		
	Land disposal	1		2,220,000		1			1			1	4						1			
	2631 Total	6	750	9,647,265	4	5	2		6	3	5	3	14		3	1		3	5	2		
2647	Pretreatment & discharge to municipal sewer	2	624	2,663,657	2	3	1	1	3	1	4	2	1	3	2	3						
2653	Pretreatment & discharge to municipal sewer	1	224	13,300	1	1			1													
2661	Pretreatment & discharge to municipal sewer	1		1,031,000	1	1	1			1	1		2	3	2			1	1	1		
	Deepwell disposal	1	100	1,000		1			1			1	1	1					1			
	2661 Total	2	100	1,032,000	1	2	1		1	1	1	1	3	4	2			1	2	1		
26	TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37	13	35	16	7	8		11	13	6		17
2813	Surface storage & evaporation	4	52	23,200	3	2				6		1	4	2		3	1	3	2			
	Deepwell disposal	1		2,400	2					1	3	1	5			1		2				
	Surface discharge	1	27	85	1						4		1			1		1				
	Pretreatment & discharge to municipal sewer	2	57	320,100	1	1							1			1		1	1			
	2813 Total	8	136	345,785	7	3				7	7	2	11	2		6	1	7	3			
2815	Pretreatment & discharge to municipal sewer	10	2,525	6,195,000	7	8	6	5	6	12	7	6	11	1	12	4	2	6	9	11		5
	Surface storage & evaporation	1	85	77,000	1	1	1		1	1	3		1					1	1	1		1
	2815 Total	11	2,610	6,272,000	8	9	7	5	7	13	10	6	12	1	12	4	2	7	10	12		6
2816	Pretreatment & discharge to municipal sewer	1	75	8,580																		
2818	Pretreatment & discharge to municipal sewer	25	5,813	29,161,361	17	48	25	1	44	17	67	17	45	5		5	7	16	45	19		41
	Deepwell disposal	7	2,251	1,723,220	23	27	8	1	37	34	45	15	57	29	26	14	9	25	27	7	1	37
	Surface storage & evaporation	5	492	694,005,560	6	6	6	1	7	3	4	2	8	1		2		3	3	4		6
	Land disposal	2	143	3,580,000	2	4	3	1	8	2	6	2	14	1	1		3	2	4	4	1	8
	Anaerobic lagoon	1		140,000																1		2
	2818 Total	40	8,699	728,610,141	48	85	42	4	96	56	122	36	124	36	27	21	19	46	79	35	2	94
2819	Deepwell disposal	3	275	525,400	6	5	5		15	13	25	7	35	4	27	7		5	5	4		13
	Pretreatment & discharge to municipal sewer	5	1,645	3,320,000	4	5	3		3	3	5	4	6	1	1	1		1	2	2		1
	Surface storage & evaporation	5	2,184	4,608,000	5	6	6		7	9	24	3	25	28	6	2		2	3	2		3
	2819 Total	13	4,104	8,453,400	15	16	14		25	25	54	14	66	33	34	10		8	10	8		17
2821	Pretreatment & discharge to municipal sewer	13	1,165	11,085,733	7	18	6	1	12	9	12	5	15		6	4	1	8	13	6	1	11
	Surface storage & evaporation	1		11,000	1				1	1			1					1				1
	Deepwell disposal	1		136,000	1				1													
	Surface disposal	4	1,270	7,434,500	5	9	4		10	10	4	2	6	5	12	3	1	4	9	4		9
	2821 Total	19	2,435	18,667,233	15	27	10	1	24	20	16	7	22	5	18	7	1	13	22	10	1	21
2822	Surface storage & evaporation	1				1							1						1			
2823	Pretreatment & discharge to municipal sewer	1		144,000	1	2	1	1	1	4		2	2	4	2	1		1	2	1	1	1
2833	Pretreatment & discharge to municipal sewer	1		1,200,000	1				1	1	1	1	1					1				1
2834	Pretreatment & discharge to municipal sewer	9	9,255	7,893,855	3	7	22	2	3	6	14	2	24	2	3	2	1	3	6	12	2	5
	Surface (spray) irrigation	1	250	230,000	1	2	1	1	2	1	2	1	4		2	1						
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	3	1	3	6	12	2	

					1972													1973													1974						
	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.
				1		1				1							1		1				1							1		1				1	
2			1		1	2			4		8	1	4			1		1													1						
1					1	1			1				1					2	2			2				2											
3			1		2	3			5		8	1	5			1		3	2			2				2					1						
	4		2		2	1	1		2	2	4	2	4	1				1	1	1		1	1	4	1	3	1				1	1	1		1	1	8
	1																																				
4	4		1		3	2	2		4	1	6	1	6	4		1		3	2	2		4	1	6	1	6	4		1		3	2	2		4	1	6
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		3	1		3	4	2		4	3	4	2	9		2	1		3	3	1		4	3	4	2	9		2	1		2	3	1		1	3	4
4						1			1			1	4						1			1			1	4						1			1		
4		3	1		3	5	2		5	3	4	3	13		2	1		3	4	1		5	3	4	3	13		2	1		2	4	1		2	3	4
1	3	2	3																																		
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1	1					1			1			1	1	1					1			1			1	1	1					1			1		
3	4	2			1	2	1		1	1	1	1	3	4	2			1	2	1		1	1	1	1	3	4	2			1	2	1		1	1	1
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			1		1						4		1			1		1						4		1			1		1						4
			1		1	1							1			1		1	1							1			1		1	1					
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1	1	12	4	2	6	9	11		5	13	2	6	7	4	12	4	2	7	10	13		5	14	7	6	10	4	12	4	2	7	10	13		5	14	8
1					1	1	1		1	1	4		1																								
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7	29	26	14	9	25	27	7	1	37	33	45	15	62	29	27	14	9	25	27	7	1	38	34	47	15	63	29	27	14	9	25	27	7	1	38	34	47
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							1		2		1									1		2		1									1		2		1
	36	27	21	19	46	79	35	2	94	50	109	32	119	36	28	18	15	45	81	33	2	95	53	122	39	118	38	29	19	15	45	81	33	2	97	54	125
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1						1							1						1							1						1					
2	4	2	1		1	2	1	1	1	4		2	2	4	2	1		1	2	1	1	1	4		2	2	4	2	1		1	2	1	1	1	4	
1					1				1	1	1	1	1			1		1				1	1	4	1	2			1		1				1	1	8
	2	3	2	1	3	6	12	2	5	6	13	2	24	8	3	2	1	3	6	12	2	6	6	13	2	26	8	3	2	1	3	6	12		4	5	14
		2	1																																		

						1975													1976													
	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	No. Firms Listing Employees
					1		1				1							1		1				1							1	2
						1													1													
						1													1													
1	3	1				1	1	1		1	1	8	1	3	1				1	1	1		1	1	8	1	3	1				2
1	6	4		1		2	1	1		3	1	5		5	4				2	1	1		3	1	5		5	4				3
2	9	5		1		3	2	2		4	2	13	1	8	5				3	2	2		4	2	13	1	8	5				5
2	9		2	1		2	3	1		1	3	4	2	9		2	1		2	3	1		1	3	4	2	9		2	1		3
1	4						1			1			1	4						1			1			1	4					1
1	13		2	1		2	4	1		2	3	4	3	13		2	1		2	4	1		2	3	4	3	13		2	1		4
	2	1	[illegible]			1	1	1			1	1		2	3	2			1	1	1			1	1		2	3	2			1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	1			1		1						4		1			1		1						4		1			1		1
	1			1		1	1							1			1		1	1							1			1		1
2	11	4		6	1	7	3				7	7	2	11	4		6	1	7	3				7	7	2	11	4		6	1	7
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15	39	7		4	3	15	46	18		44	17	68	17	41	7		4	3	15	46	18		44	17	68	17	41	7		4	3	20
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1	14	2	2		3	2	5	4	1	8	2	7	1	14	2	2		3	2	5	4	1	8	2	7	1	14	2	2		3	2
								1		2		1									1		2		1							1
40	119	40	29	19	15	46	82	33	2	98	56	130	42	123	41	29	19	15	46	82	33	2	98	56	130	42	123	41	29	19	15	32
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2	4			1		1	2	3		1	2	4	2	4			1		1	2	3		1	2	4	2	4			1		3
2	15		5	1		2	2	2		3	5	14	2	15		5	1		2	2	2		3	5	16	2	15		5	1		3
11	49	2	30	8		8	9	9		17	17	37	11	49	2	30	8		8	9	9		17	17	37	11	49	2	30	8		9
4	13		3	3	1	8	13	6	1	11	11	15	4	13		3	3	1	8	13	6	1	11	11	15	4	13		3	3	1	11
	1	1				1				1	1			1	1				1				1	1			1	1				1
2	8	3	13	3	2	3	10	4		10	13	6	2	8	5	12	3	2	3	10	4		10	13	6	2	8	5	12	3	1	3
6	22	6	16	6	3	12	23	10	1	22	25	21	6	22	6	15	6	3	12	23	10	1	22	25	21	6	22	6	15	6	2	15
	1						1							1						1							1					1
2	2	4	2	1		1	2	1	1	1	4		2	2	4	2	1		1	2	1	1	1	4		2	2	4	2	1		1
1	2			1		1				1	1	8	1	2			1		1				1	1	8	1	2			1		1
2	22	8	1	2	2	3	6	12		4	5	15	2	22	8	1	2	2	3	6	12		4	5	16	2	22	8	1	2	2	8
2	22	8	1	2	2	3	6	12		4	5	15	2	22	8	1	2	2	3	6	12		4	5	16	2	22	8	1	2	2	8
1	1					1	1			1		1	1	1					1	1			1		1	1	1					1

	Unskilled	Clerical	Other
	1		1
	4	1	
	21	2	
	26	3	1
	1		
	1		
	1		
	2		
	10	3	
1			
1	8	1	
2	2		
3	10	1	
1		1	
	1		
2		1	
2		1	
3		3	
3		3	
	2		
2	2	1	
2	4	1	
2	25	10	

[illegible]	Pretreatment & discharge to municipal sewer	2	[illegible]	2,661,657	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2653	Pretreatment & discharge to municipal sewer	1	224	13,300	1	1			1														
2661	Pretreatment & discharge to municipal sewer	1		1,831,000	1	1	1			1	1		2	3	2			1	1	1			1
	Deepwell disposal	1	100	1,000		1			1			1	1	1					1			1	
	2661 Total	2	100	1,832,000	1	2	1		1	1	1	1	3	4	2			1	2	1		1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	1	[illegible]	[illegible]	37	[illegible]	[illegible]	[illegible]	7	8		11	13	6		17	9
2813	Surface storage & evaporation	4	52	23,200	3	2				6		1	4	2		3	1	3	2				6
	Deepwell disposal	1		2,400	2					1	3	1	5			1		2					1
	Surface discharge	1	27	85	1						4		1			1		1					
	Pretreatment & discharge to municipal sewer	2	57	320,100	1	1							1			1		1	1				
	2813 Total	8	136	345,785	7	3				7	7	2	11	2		6	1	7	3				7
2815	Pretreatment & discharge to municipal sewer	10	2,525	6,195,000	7	8	6	5	6	12	7	6	11	1	12	4	2	6	9	11		5	13
	Surface storage & evaporation	1	85	77,000	1	1	1		1	1	3		1					1	1	1		1	1
	2815 Total	11	2,610	6,272,000	8	9	7	5	7	13	10	6	12	1	12	4	2	7	10	12		6	14
2816	Pretreatment & discharge to municipal sewer	1	75	8,580																			
2818	Pretreatment & discharge to municipal sewer	25	5,813	29,161,361	17	48	25	1	44	17	67	17	45	5		5	7	16	45	19		41	13
	Deepwell disposal	7	2,251	1,723,220	23	27	8	1	37	34	45	15	57	29	26	14	9	25	27	7	1	37	33
	Surface storage & evaporation	5	492	694,005,560	6	6	6	1	7	3	4	2	8	1		2		3	3	4		6	2
	Land disposal	2	143	3,580,000	2	4	3	1	8	2	6	2	14	1	1		3	2	4	4	1	8	2
	Anaerobic lagoon	1		140,000																1		2	
	2818 Total	40	8,699	728,610,141	48	85	42	4	96	56	122	36	124	36	27	21	19	46	79	35	2	94	50
2819	Deepwell disposal	3	275	525,400	6	5	5		15	13	25	7	35	4	27	7		5	5	4		13	9
	Pretreatment & discharge to municipal sewer	5	1,645	3,320,000	4	5	3		3	3	5	4	6	1	1	1		1	2	2		1	1
	Surface storage & evaporation	5	2,184	4,608,000	5	6	6		7	9	24	3	25	28	6	2		2	3	2		3	5
	2819 Total	13	4,104	8,453,400	15	16	14		25	25	54	14	66	33	34	10		8	10	8		17	15
2821	Pretreatment & discharge to municipal sewer	13	1,165	11,085,733	7	18	6	1	12	9	12	5	15		6	4	1	8	13	6	1	11	11
	Surface storage & evaporation	1		11,000	1				1	1			1					1				1	1
	Deepwell disposal	1		136,000	1				1														
	Surface disposal	4	1,270	7,434,500	5	9	4		10	10	4	2	6	5	12	3	1	4	9	4		9	10
	2821 Total	19	2,435	18,667,233	15	27	10	1	24	20	16	7	22	5	18	7	1	13	22	10	1	21	22
2822	Surface storage & evaporation	1				1							1						1				
2823	Pretreatment & discharge to municipal sewer	1		144,000	1	2	1	1	1	4		2	2	4	2	1		1	2	1	1	1	4
2833	Pretreatment & discharge to municipal sewer	1		1,200,000	1				1	1	1	1	1					1				1	1
2834	Pretreatment & discharge to municipal sewer	9	9,255	7,893,855	3	7	22	2	3	6	14	2	24	2	3	2	1	3	6	12	2	5	6
	Surface (spray) irrigation	1	250	230,000	1	2	1	1	2	1	2	1	4		2	1							
	2834 Total	10	9,505	8,123,855	4	9	23	3	5	7	16	3	28	2	5	3	1	3	6	12	2	5	6
2840	Pretreatment & discharge to municipal sewer	2	695	540,000	2	2	1		2	1	3	1	2					1	1			1	
2841	Pretreatment & discharge to municipal sewer	2		51,000	1	4	2	1		1		1	8	3	1		1	1	4	1	1		1
	Deepwell disposal	2	27	4,450	1		1		1				1					1		1		1	
	2841 Total	4	27	55,450	2	4	3	1	1	1		1	9	3	1		1	2	4	2	1	1	1
2842	Pretreatment & discharge to municipal sewer	2	140	209,000	2	3	2		2				2					2	3	2		2	
2843	Pretreatment & discharge to municipal sewer	1	11	8,000			1			1			1			1							
2844	Pretreatment & discharge to municipal sewer	2	851	136,000	2	2	2	2		2								2	2	2	2		2
2851	Pretreatment & discharge to municipal sewer	2	550	2,190,000	2	4	2		1	1	3	1						2	4	2		1	1
2861	Pretreatment & discharge to municipal sewer	1	340	1,040,000	1	1	1			1			1		1			1	1	1			1
2871	Pretreatment & discharge to municipal sewer	1	70	2,160	1					1			1		2			1					1
	Surface storage & evaporation	3		138,500	3	3	3		3	3			6			2		3	3	3		3	3
	2871 Total	4	70	140,660	4	3	3		3	4			7		2	2		4	3	3		3	4
2879	Pretreatment & discharge to municipal sewer	1	272	600,000	1	1			2	1	1		1					1	1			3	1
2891	Pretreatment & discharge to municipal sewer	5	241	87,790	1		1		2	1	1		3	1		1		1		1		1	1
2899	Pretreatment & discharge to municipal sewer	6	486	883,900	4	3	2		1	2	2	2	7		1			4	2	1		1	1
	Deepwell disposal	1		86,400	1	1	1					1	1		1	1		1	1	1			
	Surface discharge	1	65	5,200		2													1				
	2899 Total	8	551	975,500	5	6	3		1	2	2	3	8		2	1		5	4	2		1	1
28	TOTAL	137	31,312	777,807,394	121	178	116	16	173	148	236	77	301	87	104	57	25	107	156	93	9	158	131

	3	5	2		5	3	4	3	13		2	1		3	4	1
	1	1	1			1	1		2	3	2			1	1	1
		1			1			1	1	1					1	
	1	2	1		1	1	1	1	3	4	2			1	2	1
	11	13	6		17	9	25	8	31	9	4	3		11	11	5
1	3	2				6		1	4	4		3	1	3	2	
	2					1	3	1	5			1		2		
	1						4		1			1		1		
	1	1							1			1		1	1	
1	7	3				7	7	2	11	4		6	1	7	3	
2	6	9	11		5	13	2	6	7	4	12	4	2	7	10	13
	1	1	1		1	1	4		1							
2	7	10	12		6	14	6	6	8	4	12	4	2	7	10	13
7	16	45	19		41	13	53	14	37	5		3	3	15	46	18
9	25	27	7	1	37	33	45	15	62	29	27	14	9	25	27	7
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1	2	4	2	1	1	1		1	11	3	1		1	2	6	2
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	2	2	2	2		2								2	2	2
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		1													1	
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	[illegible]	136	93	9	158	131	193	68	268	67	95	49	24	106	159	92

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		1	3	1	5			1		2					1	3	1	5			1		
			4		1			1		1						4		1			1		
					1			1		1	1							1			1		
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	17	16	34	11	48	2	30	8		8	9	9		17	17	37	11	49	2	30	8		
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	1	1	4	1	2			1		1				1	1	8	1	2			1		1
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2	6	6	13	2	26	8	3	2	1	3	6	12		4	5	14	2	22	8	1	2	2	3
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	1				1					1		1		1				1					1
1	1	1		1	13	3	1		1	1	6	3	2	1	1		2	13	4	1		1	2
	2				2					2	3	2		2				2	1				2
2		2								2	2	2	2		2								2
	1	1	3	2					2	1		2		1	1	3	2					2	1
		1			1		1			1	1	1			1			1		1			1
		1			1		2			1					1			1		2			1
	3	3			6			2		3	3	3		3	3			6			2		3
	3	4			7		2	2		4	3	3		3	4			7		2	2		4
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	1	1	1		3	1				1		1		1	1	1		3	1				1
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		2	22	8	1	2	2	3	6	12		4	5	15	2	22	8	1	2	2	3	6	12		4	5	16	2	22	8	1	2	2	8
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									1													1												1
		3	8		2	1		5	4	2		1	1	2	3	8		2	1		5	4	2		1	1	2	3	8		2	1		5
		78	274	74	96	50	26	110	158	98	9	163	142	233	80	278	76	96	50	26	105	158	100	9	165	141	235	80	279	75	96	50	25	103

Table 4. Manpower needs according to industry group (SIC Code) and water abatement practices (Environmental Pr

SIC Category (Plants Reporting)	Waste Abatement Practices	Number Plants Reporting Waste Treatment Practice	Least Number of Production Employees	Discharge Flow Gallons/Day	1971													1972					
					Superintend.	Eng./San.E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.
1925	Surface (spray) irrigation	1	-	50,000		1				1	1		1		1								
2010	Pretreatment & discharge to municipal sewer	1	150	5,000									7										
2011	Surface storage & evaporation	4	250	53,130	1	1				1				1	2			1	1				
	Surface (spray) irrigation	1	50	15,000	1								2					1					
	Pretreatment & discharge to municipal sewer	18	5,187	10,003,000	5	9	4	3	5	6	14	2	18	3	10	3	2	4	4	2	1	3	5
	2011 Total	23	5,442	10,071,130	7	10	4	3	5	7	14	2	20	4	12	3	2	6	5	2	1	3	5
2013	Pretreatment & discharge to municipal sewer	5	1,645	640,000	2	1	2	1		1			1	1	1	1							
	Lagoon-evaporation	1	110	24,000									1										
	2013 Total	6	1,755	664,000	2	1	2	1		1			2	1	1	1							
2015	Pretreatment & discharge to municipal sewer	13	2,750	6,457,680	7	7	1	5	7	8	1		27	3	9	6	6	6	5		5	6	8
	Surface storage & evaporation	1	42	25,300									1		1								
	2015 Total	14	2,792	6,482,980	7	7	1	5	7	8	1		28	3	10	6	6	6	5		5	6	8
2023	Pretreatment & discharge to municipal sewer	2	120	114,000	2			1					1					2			1		
2024	Pretreatment & discharge to municipal sewer	1	28	13,000																			
2026	Pretreatment & discharge to municipal sewer	2	185	184,000	2	3		1	4	3	10	1	7	9	28	3		2	3		4	3	8
	Surface (spray) irrigation	2	143	53,000	1	1	2		1	1	1		2	1	1		1	1	1	2		1	1
	2026 Total	4	328	237,000	3	4	2	1	5	4	11	1	9	10	29	3	1	3	4	2	4	4	9
2032	Pretreatment & discharge to municipal sewer	2	350	1,715,560	2	3	2	2	2	1		1	3	1	2	1		2	3	2	2	2	1
2033	Pretreatment & discharge to municipal sewer	15	7,177	11,093,400	7	8	7	2	8	5	5		15	7	3	2	3	5	8	7	2	6	5
	Surface (spray) irrigation	14	2,972	3,914,424	6	7	4		8	7	3	1	10	5	4		2	1	1	2		2	3
	Deepwell disposal	1	400	2,200,000	1	1			3	1	1		1	1	4			1	1			2	1
	2033 Total	30	10,549	17,207,824	14	16	11	2	19	13	9	1	26	13	11	2	5	7	10	9	2	10	9
2035	Pretreatment & discharge to municipal sewer	1	35	20,000									1										
2036	Surface (spray) irrigation	1	540	200,000		1	1			1	1		1	2									1
2037	Surface (spray) irrigation	7	512	2,476,600	3	2	1	1	2	3	1		4	3	1			3	2	1	1	2	3
	Treatment & discharge to stream	2	900	2,580,000		1		1	2	3			1	1	1	1			1		1	2	3
	Deepwell injection	1	100	4,320,000		1					1		1						1				
	Pretreatment & discharge to municipal sewer	11	3,754	1,457,000	8	7	3	2	5	4	15	2	16	3	8	4	5	8	6	3	2	5	4
	2037 Total	21	5,266	10,833,600	11	11	4	4	9	10	17	2	22	7	10	5	5	11	10	4	4	9	10
2042	Pretreatment & discharge to municipal sewer	2	0	529,000	1	1	1		1	1	1	1	2		1			1					
2046	Pretreatment & discharge to municipal sewer	2	657	1,075,600	1	7	2	2	2		1	2			1		6	1	7	2	2	2	
2051	Pretreatment & discharge to municipal sewer	2	50	165,000		2			1	1	2		1						2			1	1
2061	Surface (spray) irrigation	3	152	45,175,000	3	1			3	3	1		3		1	1	5	3	1			2	3
	Surface storage & evaporation	1		40,000		1					1				2				1				1
	2061 Total	4	152	45,215,000	3	2			3	3	2		3		3	1	5	3	2			2	4
2062	Pretreatment & discharge to municipal sewer	1		670,000	1				3	3	3		1										
	Surface storage & evaporation	1			1		1		2				1					1		1		2	
	2062 Total	2		670,000	2		1		5	3	3		2					1		1		2	
2072	Pretreatment & discharge to municipal sewer	1	12	130		1	1																
2082	Pretreatment & discharge to municipal sewer	1		320,331	1	2	1	1	1				1			1		1	2	1	1	1	
2084	Surface discharge	1		28,000			1		1	1		1	1							1		1	2
2085	Surface discharge	2	94	58,000	1					1			2		1	1		1					1
	Pretreatment & discharge to municipal sewer	2	155	27,818	1	1	2		1		1	1	2	1	1			1	1	2		1	1
	Surface (spray) irrigation	1	250	1,536,000	1		1		1	1	1	1	2			1							
	2085 Total	5	499	1,621,818	3	1	3		2	2	2	2	6	1	2	2		2	1	2		1	2
2090	Pretreatment & discharge to municipal sewer	1	4,375	1,830,000		1			2		7	1	1		1				1			2	

ctices (Environmental Protection Agency).

1972														1973														1974												
Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr.Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other
								7													7													7				
1	1								2	2			1	1									2			1	1									2		
1								2					1								2					1								2				
4	4	2	1	3	5	9	1	7	4	2	3	1	3	3	1	1	3	2	2	1	6	3	2	2		3	3	1	1	3	2	2	1	6	3	2	2	
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								2		1																													
								1													1													1				
								3		1											1													1				
6	5		5	6	8	3		22	2	9	6	5	3				1	5	3		7	2	5	1		3				1	5	3		7	2	5	1	
6	5		5	6	8	3		22	2	9	6	5	3				1	5	3		7	2	5	1		3				1	5	3		7	2	5	1	
2			1					1					1								1					1								1				
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	1	2		1	2	6	1	4	1	2	1		2	1	2		1	2	6	1	4	1	[illegible]	[illegible]														

	1975													1976													
	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	No. Firms Listing Employees
									7													7					1
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	1								2					1								2					1
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	3				1	5	3		7	2	5	1		3				1	5	3		7	2	5	1		6
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		1				1					2				1				1					2			1
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		1			2		7	1	1		2				1			2		7	1	1		2			1

2024	Pretreatment & discharge to municipal sewer	1	28	13,000																			
2026	Pretreatment & discharge to municipal sewer	2	185	184,000	2	3		1	4	3	10	1	7	9	28	3		2	3		4	3	8
	Surface (spray) irrigation	2	143	53,000	1	1	2		1	1	1		2	1	1		1	1	1	2		1	1
	2026 Total	4	328	237,000	3	4	2	1	5	4	11	1	9	10	29	3	1	3	4	2	4	4	9
2032	Pretreatment & discharge to municipal sewer	2	350	1,715,560	2	3	2	2	2	1		1	3	1	2	1		2	3	2	2	2	1
2033	Pretreatment & discharge to municipal sewer	15	7,177	11,093,400	7	8	7	2	8	5	5		15	7	3	2	3	5	8	7	2	6	5
	Surface (spray) irrigation	14	2,972	3,914,424	6	7	4		8	7	3	1	10	5	4		2	1	1	2		2	3
	Deepwell disposal	1	400	2,200,000	1	1			3	1	1		1	1	4			1	1			2	1
	2033 Total	30	10,549	17,207,824	14	16	11	2	19	13	9	1	26	13	11	2	5	7	10	9	2	10	9
2035	Pretreatment & discharge to municipal sewer	1	35	20,000									1										
2036	Surface (spray) irrigation	1	540	200,000		1	1			1	1		1	2									1
2037	Surface (spray) irrigation	7	512	2,476,600	3	2	1	1	2	3	1		4	3	1			3	2	1	1	2	3
	Treatment & discharge to stream	2	900	2,580,000		1		1	2	3			1	1	1	1			1		1	2	3
	Deepwell injection	1	100	4,320,000		1					1		1						1				
	Pretreatment & discharge to municipal sewer	11	3,754	1,457,000	8	7	3	2	5	4	15	2	16	3	8	4	5	8	6	3	2	5	4
	2037 Total	21	5,266	10,833,600	11	11	4	4	9	10	17	2	22	7	10	5	5	11	10	4	4	9	10
2042	Pretreatment & discharge to municipal sewer	2	0	529,000	1	1	1		1	1	1	1	2		1			1					
2046	Pretreatment & discharge to municipal sewer	2	657	1,075,600	1	7	2	2	2		1	2			1		6	1	7	2	2	2	
2051	Pretreatment & discharge to municipal sewer	2	50	165,000		2			1	1	2		1						2			1	1
2061	Surface (spray) irrigation	3	152	45,175,000	3	1			3	3	1		3		1	1	5	3	1			2	3
	Surface storage & evaporation	1		40,000		1					1				2				1				1
	2061 Total	4	152	45,215,000	3	2			3	3	2		3		3	1	5	3	2			2	4
2062	Pretreatment & discharge to municipal sewer	1		670,000	1				3	3	3		1										
	Surface storage & evaporation	1			1		1		2				1					1		1		2	
	2062 Total	2		670,000	2		1		5	3	3		2					1		1		2	
2072	Pretreatment & discharge to municipal sewer	1	12	130		1	1																
2082	Pretreatment & discharge to municipal sewer	1		320,331	1	2	1	1	1				1			1		1	2	1	1	1	
2084	Surface discharge	1		28,000			1		1	1		1	1							1		1	2
2085	Surface discharge	2	94	58,000	1					1			2		1	1		1					1
	Pretreatment & discharge to municipal sewer	2	155	27,818	1	1	2		1		1	1	2	1	1			1	1	2		1	1
	Surface (spray) irrigation	1	250	1,536,000	1		1		1	1	1	1	2			1							
	2085 Total	5	499	1,621,818	3	1	3		2	2	2	2	6	1	2	2		2	1	2		1	2
2090	Pretreatment & discharge to municipal sewer	1	4,375	1,830,000		1			2		7	1	1		1				1			2	
2091	Pretreatment & discharge to municipal sewer	1	1,200	600,000		7					25	5	10		3	2							
2092	Pretreatment & discharge to municipal sewer	2		204,000	2	2	1		2	9	8	1	2		5			1					5
2093	Pretreatment & discharge to municipal sewer	1	90	76,000		1			1		1	1	1						1			1	
2096	Pretreatment & discharge to municipal sewer	4	171	1,063,200	3	2	3		4	1	2	2	4	1	4	1	2	2	2	2		3	2
2097	Pretreatment & discharge to municipal sewer	1	165	400,000		1	1		1	3			2	1		1			1	1		1	3
2099	Pretreatment & discharge to municipal sewer	12	1,191	2,052,115	2	6	4	1	1	2	2		6	4	2		1	1	5	4	1	1	2
	Biological treatment & surface discharge	2	25	315,000		1				1	1								1				1
	2099 Total	14	1,216	2,367,115	2	7	4	1	1	3	3		6	4	2		1	1	6	4	1	1	3
20	TOTAL	150	35,942	103,729,288	66	90	46	23	74	72	110	23	162	48	97	29	33	50	62	33	23	56	65
2211	Pretreatment & discharge to municipal sewer	1	202	15,000													2						
2221	Pretreatment & discharge to municipal sewer	2	670	144,000							1		1										
2231	Pretreatment & discharge to municipal sewer	1		80,000	1		1		1				2				8						
	Surface storage & evaporation	1	238	1,000,000								1			1			1		1		1	
	2231 Total	2	238	1,080,000	1		1		1			1	2		1		8	1		1		1	
2269	Pretreatment & discharge to municipal sewer	2	836	2,510,000					2				4									2	
2299	Pretreatment & discharge to municipal sewer	1	961	92,000		1						1	1										
22	TOTAL	8	2,907	3,841,000		1	1		3		1	2	8		1		10	1		1		3	

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	1					1		1							
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				2				4							
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						3																	
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			1		1	2		1	2							1		1	2		1	2					1
	1					1			2		1	1		1					1			2		1	1		2
	1	1	2		1	1	6	1	2	1	1			1	1	2		1	1	6	1	2	1	1			2
	2	1	2		1	2	6	1	4	1	2	1		2	1	2		1	2	6	1	4	1	2	1		4
		1			2		7	1	1		2				1			2		7	1	1		2			1
	1					5	8		1		5			1					5	8		1		5			1
2	2	2	2		3	2	4	1	3		3		2	2	2	2		3	2	4	1	3		3		2	3
		1	1		1	3			2	1		1			1	1		1	3			2	1		1		1
	1	5	4	1	1	2			6	2	3			1	5	4	1	1	2			6	2	3			6
		1				1	1		2						1				1	1		2					2
	1	6	4	1	1	3	1		8	2	3			1	6	4	1	1	3	1		8	2	3			8
18	41	50	29	18	39	54	67	14	93	56	51	14	17	43	50	26	19	40	55	69	14	93	57	51	14	17	81
							1		1											1		1					2
5	2	1	1		1			1	3		1		5	2	1	1		1			1	3		1		5	2
5	2	1	1		1			1	3		1		5	2	1	1		1			1	3		1		5	2
					2				4									2				4					2
5	2	1	1		3		1	1	8		1		5	2	1	1		3		1	1	8		1		5	6

SIC Category (Plants Reporting)	Waste Abatement Practices	Number Plants Reporting Waste Treatment Practice	Least Number of Production Employees	Discharge Flow Gallons/Day	1971													1972						
					Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.
2911	Pretreatment & discharge to municipal sewer	4	611	1,685,900	3	2	5		2	1	1		2		1	1	1	3	2	5		2	1	1
	Surface discharge	3		8,135,164	2	3	1		1	1	8	1	1	14	5	3	2	1	1				1	8
	Surface storage & evaporation	1	57	45,000	1	1	1		5				5			1								
	Deepwell disposal	2		20,000	4	3	1		9	8	11	3	26		21	2		4	3	1		9	8	11
29	TOTAL	10	668	9,886,064	10	9	8		17	10	20	4	34	14	27	7	3	8	6	6		11	10	20
3069	Pretreatment & discharge to municipal sewer	3	902	346,300	1		1		1				3	1	1					1		1		
3079	Pretreatment & discharge to municipal sewer	5	721	78,500	4	1		1		2			3		1			3	1				2	
	Surface disposal	1	160	229,600		1							1						1					
	3079 Total	6	881	308,100	4	2		1		2			4		1			3	2				2	
30	TOTAL	9	1,783	654,400	5	2	1	1	1	2			7	1	2			3	2	1		1	2	
3292	Pretreatment & discharge to municipal sewer	1		42,000	1	1					2		1					1	1					2
3296	Surface storage & evaporation	1	280	410,000	1				1			2					3	1				1		
32	TOTAL	2	280	452,000	2	1			1		2	2	1				3	2	1			1		2
3312	Surface (spray) irrigation	1		800,000		1							2											
	Surface storage & evaporation	1		32,500	1	2	4		5	1		1	1			1	1							
	Surface discharge	3	885	4,530,000	2	2	3		9	5		1	6					1	1	1		5	5	
	Pretreatment & discharge to municipal sewer	3	1,470	286,000	1	2	2		1	1	1	1	8					1	2	2		1	1	1
	3312 Total	8	2,355	5,648,500	4	7	9		15	7	1	3	17			1	1	2	3	3		6	6	1
3315	Pretreatment & discharge to municipal sewer	3	211	724,000		1	2		3	1			3	2					1			3		
3316	Pretreatment & discharge to municipal sewer	1	2,800	261,000	8	4	3		2	16	17	3	20		9	3		8	4	3		2	16	17
3317	Pretreatment & discharge to municipal sewer	1		200,000			2		1				2	1						2		1		
3321	Pretreatment & discharge to municipal sewer	5	1,616	484,160	3	2	1		4	4	3	1	5	1	7	1		2	2	1		4	2	3
	Surface storage & evaporation	1	1,000	600,000		1	1		1					2	2				1	1		1		
	Deepwell disposal	1	175	484,800																				
	3321 Total	7	2,791	1,586,960	3	3	2		5	4	3	1	5	3	9	1		2	3	2		5	2	3
3330	Deepwell disposal	1	60	200,000	1		1		3	1		1	2					1		1		6	1	1
3334	Surface discharge	1		120,000	1	3	1		1	1		1	5			1		1	3	1		1	1	
3339	Surface storage & evaporation	1	250	64,000	1	1				1	1	1	1		1			1	1				1	1
3341		3	250	186,800	3	2	3		2	1	1	2	3		3			2	1	2		2	1	1
3351	Pretreatment & discharge to municipal sewer	9	5,048	2,396,660	2	8	2		1		3	4	6	4	4	1		2	7	3		1		3
	Surface storage & evaporation	1	76	2,100									2											
	3351 Total	10	5,124	2,398,760	2	8	2		1		3	4	8	4	4	1		2	7	3		1		3
3352	Pretreatment & discharge to municipal sewer	1		5,000			1	1		1	3		2	3		3				2	2		1	3
	Surface discharge	1	160	108,000	1					1	1							1					1	1
	3352 Total	2	160	113,000	1		1	1		2	4		2	3		3		1		2	2		2	4
3356	Pretreatment & discharge to municipal sewer	3	350	286,000	2	3	2	1	3	3	2	1	4		2	1		1	2	1		2	2	1
	Surface storage & evaporation	1		1,650,000	1	2	2		2	1	4	1	1	2	1	1		1	4	3		2	1	4
	3356 Total	4	350	1,936,000	3	5	4	1	5	4	6	2	5	2	3	2		2	6	4		4	3	5
3357	Pretreatment & discharge to municipal sewer	1		3,500			1				1		1							1				1
3362	Pretreatment & discharge to municipal sewer	1	20	60,000		1			1				1						1			1		
3381	Deepwell disposal	1	273	3,000						1	1		1										1	1
33	TOTAL	45	14,644	13,505,520	27	35	31	2	39	39	38	18	76	15	29	12	1	22	30	24	2	32	34	38
3441	Pretreatment & discharge to municipal sewer	1	175	3,000	1					1			2	3	2									
3471	Pretreatment & discharge to municipal sewer	1	280	97,000		2	1		2	1	1		2	1										
	Surface storage & evaporation	1	200	6,000			1		1				1											
	3471 Total	2	480	103,000		2	2		3	1	1		3	1										
[illegible]	Surface disposal	1		31,400	1						1		1					1						1

1972												1973													1974									
Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op. /Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant
2	5		2	1	1		3		1	1	1	1		3						2		1		1	1		3						2	
1				1	8	1	1		5	2		1	1				1	8	1	1		5	2		1	1				1	7	1	1	
3	1		9	8	11	3	26		21	2		4	3	1		9	8	11	3	26		21	2		4	3	1		9	8	11	3	26	
6	6		11	10	20	4	30		27	5	1	6	4	4		9	9	19	4	29		27	4	1	6	4	4		9	9	18	4	29	
	1		1				1		1					1		1				1		1					1		1				1	
1				2			3		1			3	1				2			3		1			3					2			3	
1							1						1							1						1							1	
2				2			4		1			3	2				2			4		1			3	2				2			4	
2	1		1	2			5		2			3	2	1		1	2			5		2			3	2	1		1	2			5	
1					2		1					1	1					2		1					1	1					2		1	
			1			2					3																							
1			1		2	2	1				3	1	1					2		1					1	1					2		1	
1	1		5	5			6					1	1	1		5	5			6					1	1	1		5	5			6	
2	2		1	1	1	1	9	1				1	2	2		1	1	1	1	9	1	1			1	1	2		1	1			7	
3	3		6	6	1	1	15	1				2	3	3		6	6	1	1	15	1	1			2	2	3		6	6			13	
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	2		1				2	1						2		2			1	2	1						2		2			1	2	
2	1		4	2	3	1	6	1	7	1		2	2	1		4	2	3	1	7	1	7	1		2	3	2		4	2	3	1	8	
1	1		1					2	2				1	1		1					2	2				1	1		1					
3	2		5	2	3	1	6	3	9	1		2	3	2		5	2	3	1	7	3	9	1		2	4	3		5	2	3	1	8	
	1		6	1	1	2	2					1		1		6	1	1	2	2					1		1		6	1	1	2	2	
3	1		1	1		1	5	1		1		1	3	1		1	1		1	5	1		1		1	3	1		1	1		1	5	
1				1	1	1	1		1			1	1				1	1	1	1		1			1	1				1	1	1	1	
1	2		2	1	1	2	2	1	4			2	1	2		2	2	1	2	2	2	5												
7	3		1		3	4	5	2	2	1		1	7	3		1		3	3	6	2		1		1	5	3		1		6	3	5	
							1													1													1	
7	3		1		3	4	6	2	2	1		1	7	3		1		3	3	7	2		1		1	5	3		1		6	3	6	
	2	2		1	3		2	3		3				2	2		1	3		2	3		3				2	2		1	3		2	
				1	1							1					1	1							1					1	1			
	2	2		2	4		2	3		3		1		2	2		2	4		2	3		3		1		2	2		2	4		2	
2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3	
4	3		2	1	4	1	1	2	1	1		1	5	3		3	1	5	1	2	2	2	1		1	4	3		3	1	5	1	2	
[illegible]	4		4	3	5	2	4	2	3	1		2	7	4		5	3	6	2	5	2	4	1		2	6	4		5	3	6	2	5	
	1				1		1							1				1		1							1				1		1	
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				1	1		1										1	1		1										1	1		1	
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					1		1					1						1		1					1						1		1	
					1		1					1						1		1					1						1		1	
					1		1					1						1		1					1						1		1	
									1													1												
[illegible]	1		3				2	2				1	1	1						1	1				1	1	1						1	1
			1	2	[illegible]		[illegible]		2																									

			1975													1976													No. Firms Listing Employees
Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	Superintend.	Eng./San. E.	Chemist	Biologist	Lab. Tech.	Sr. Op./Fo.	Eq. Oper.	Inst. Rep.	Maint. Man	Attendant	Unskilled	Clerical	Other	
1		1	1		3						2		1		1	1		3						2		1		1	2
4	1		1	1				1	7	1	1		4	1		1	1				1	6	1	1		4	1		1
21	2		4	3	1		9	8	11	3	26		21	2		4	3	1		9	8	11	3	26		21	2		2
26	3	1	6	4	4		9	9	18	4	29		26	3	1	6	4	4		9	9	17	4	29		26	3	1	5
1					1		1				1		1					1		1				1		1			1
1			3	1				2			3		1			3	1				2			3		1			4
				1							1						1							1					1
1			3	2				2			4		1			3	2				2			4		1			5
2			3	2	1		1	2			5		2			3	2	1		1	2			5		2			6
			1	1					2		1					1	1					2		1					1
			1	1					2		1					1	1					2		1					1
			1	1	1		5	5			6					1	1	1		5	5			6					1
			1	1	2		1	1			7							1						1					1
			2	2	3		6	6			13					1	1	2		5	5			7					2
				1			3				1						1			3				1					1
10	3		8	4	3		2	16	17	4	20		10	3		8	4	3		2	16	17	4	20		10	3		1
					2		2			1	2	1						2		2			1	2	1				1
8	1		1	1	1		3	1	1		2		1							1		1		2					1
2																													
10	1		1	1	1		3	1	1		2		1							1		1		2					1
			1		1		6	1	1	2	2					1		1		6	1	1	2	2					1
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											1													1					1
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	3				2	2		1	3		2	3		3				2	2		1	3		2	3		3		1
			1					1	1							1					1	1							1
	3		1		2	2		2	4		2	3		3		1		2	2		2	4		2	3		3		2
2			1	2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3		2			2
2	1		1	2	2		3	1	5	1	2	2	2	1		1	2	2		3	1	5	1	2	3	2	1		1
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					1				1		1							1				1		1					1
				1			1				1						1			1				1					1
								1	1		1										1	1		1					1
25	10		18	21	20	2	31	32	38	14	62	9	16	9		16	19	18	2	28	30	38	14	56	10	15	9		24
			1						1		1																		

32	TOTAL	2	280	452,000	2	1			1		8	8	1										
3312	Surface (spray) irrigation	1		800,000		1							2										
	Surface storage & evaporation	1		32,500	1	2	4		5	1		1	1			1	1						
	Surface discharge	3	885	4,530,000	2	2	3		9	5		1	6					1	1	1		5	
	Pretreatment & discharge to municipal sewer	3	1,470	286,000	1	2	2		1	1	1	1	8					1	2	2		1	
	3312 Total	8	2,355	5,648,500	4	7	9		15	7	1	3	17			1	1	2	3	3		6	
3315	Pretreatment & discharge to municipal sewer	3	211	724,000		1	2		3	1			3	2					1			3	
3316	Pretreatment & discharge to municipal sewer	1	2,800	261,000	8	4	3		2	16	17	3	20		9	3		8	4	3		2	1
3317	Pretreatment & discharge to municipal sewer	1		200,000			2		1				2	1						2		1	
3321	Pretreatment & discharge to municipal sewer	5	1,616	484,160	3	2	1		4	4	3	1	5	1	7	1		2	2	1		4	
	Surface storage & evaporation	1	1,000	600,000		1	1		1					2	2				1	1		1	
	Deepwell disposal	1	175	484,800																			
	3321 Total	7	2,791	1,586,960	3	3	2		5	4	3	1	5	3	9	1		2	3	2		5	
3330	Deepwell disposal	1	60	200,000	1		1		3	1		1	2					1		1		6	
3334	Surface discharge	1		120,000	1	3	1		1	1		1	5			1		1	3	1		1	
3339	Surface storage & evaporation	1	250	64,000	1	1				1	1	1	1		1			1	1				
3341		3	250	186,800	3	2	3		2	1	1	2	3		3			2	1	2		2	
3351	Pretreatment & discharge to municipal sewer	9	5,048	2,396,660	2	8	2		1		3	4	6	4	4	1		2	7	3		1	
	Surface storage & evaporation	1	76	2,100									2										
	3351 Total	10	5,124	2,398,760	2	8	2		1		3	4	8	4	4	1		2	7	3		1	
3352	Pretreatment & discharge to municipal sewer	1		5,000			1	1		1	3		2	3		3				2	2		
	Surface discharge	1	160	108,000	1					1	1							1					
	3352 Total	2	160	113,000	1		1	1		2	4		2	3		3		1		2	2		
3356	Pretreatment & discharge to municipal sewer	3	350	286,000	2	3	2	1	3	3	2	1	4		2	1		1	2	1		2	
	Surface storage & evaporation	1		1,650,000	1	2	2		2	1	4	1	1	2	1	1		1	4	3		2	
	3356 Total	4	350	1,936,000	3	5	4	1	5	4	6	2	5	2	3	2		2	6	4		4	
3357	Pretreatment & discharge to municipal sewer	1		3,500			1				1		1							1			
3362	Pretreatment & discharge to municipal sewer	1	20	60,000		1			1				1						1			1	
3381	Deepwell disposal	1	273	3,000						1	1		1										
33	TOTAL	45	14,644	13,505,520	27	35	31	2	39	39	38	18	76	15	29	12	1	22	30	24	2	3	
3441	Pretreatment & discharge to municipal sewer	1	175	3,000	1					1			2	3	2								
3471	Pretreatment & discharge to municipal sewer	1	280	97,000		2	1		2	1	1		2	1									
	Surface storage & evaporation	1	200	6,000			1		1				1										
	3471 Total	2	480	103,000		2	2		3	1	1		3	1									
3481	Surface disposal	1		31,400	1						1		1					1					
		1		200																			
	3481 Total	2		31,600	1						1		1					1					
34	TOTAL	5	655	137,600	2	2	2		3	2	2		6	4	2			1					
3551	Pretreatment & discharge to municipal sewer	1	400	200											1								
3623	Pretreatment & discharge to municipal sewer	2	388	118,000	1	2	1		2				2	2				1	2	1			
3711	Pretreatment & discharge to municipal sewer	5	12,817	3,523,000	4	2			1	3	9		10		2			4	2				
3713	Pretreatment & discharge to municipal sewer	1		2,400						1			1	3									
3714	Pretreatment & discharge to municipal sewer	1	6,687	2,190,000		1					10								1				
37	TOTAL	7	19,504	5,715,400	4	3			1	4	19		11	3	2			4	3				
3842	Surface (spray) irrigation	1	104	300	1						1		1					1					
4783	Pretreatment & discharge to municipal sewer	1	5	500	1					1	1							1					
4941	Pretreatment & discharge to municipal sewer	1	3	36,250	1	1	1	1		1		1	1					1	1	1	1		
4952	Surface discharge	1		130,000	1		1			1						1		1		1			
49	TOTAL	2	3	166,250	2	1	2	1		2		1	1			1		2	1	2	1		
5086	Pretreatment & discharge to municipal sewer	1	290	720,000		1							8										

	3	1				1			2					3																							
	3	2	1			1		2	2	1				3	1	1					2		1					1	1					2		1	
	1																																				
		1	1	1		[illegible]	[illegible]			6					1	1	1		[illegible]	[illegible]			6					1	1	1		[illegible]	[illegible]			6	
		1	2	2		1	1	1	1	9	1				1	2	2		1	1	1	1	9	1	1			1	1	2		1	1			7	
	1	2	3	3		6	6	1	1	15	1				2	3	3		6	6	1	1	15	1	1			2	2	3		6	6			13	
			1			3				2	1					1			3				1						1			3				1	
3		8	4	3		2	16	17	4	20		10	3		8	4	3		2	16	17	4	20		10	3		8	4	3		2	16	17	4	20	
				2		1				2	1						2		2			1	2	1						2		2			1	2	
1		2	2	1		4	2	3	1	6	1	7	1		2	2	1		4	2	3	1	7	1	7	1		2	3	2		4	2	3	1	8	
			1	1		1					2	2				1	1		1					2	2				1	1		1					
1		2	3	2		5	2	3	1	6	3	9	1		2	3	2		5	2	3	1	7	3	9	1		2	4	3		5	2	3	1	8	
		1		1		6	1	1	2	2					1		1		6	1	1	2	2					1		1		6	1	1	2	2	
1		1	3	1		1	1		1	5	1		1		1	3	1		1	1		1	5	1		1		1	3	1		1	1		1	5	
		1	1				1	1	1	1		1			1	1				1	1	1	1		1			1	1				1	1	1	1	
		2	1	2		2	1	1	2	2	1	4			2	1	2		2	2	1	2	2	2	5												
1		2	7	3		1		3	4	5	2	2	1		1	7	3		1		3	3	6	2		1		1	5	3		1		6	3	5	
										1													1													1	
1		2	7	3		1		3	4	6	2	2	1		1	7	3		1		3	3	7	2		1		1	5	3		1		6	3	6	
3				2	2		1	3		2	3		3				2	2		1	3		2	3		3				2	2		1	3		2	
		1					1	1							1					1	1							1					1	1			
3		1		2	2		2	4		2	3		3		1		2	2		2	4		2	3		3		1		2	2		2	4		2	
1		1	2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3	
1		1	4	3		2	1	4	1	1	2	1	1		1	5	3		3	1	5	1	2	2	2	1		1	4	3		3	1	5	1	2	
2		2	6	4		4	3	5	2	4	2	3	1		2	7	4		5	3	6	2	5	2	4	1		2	6	4		5	3	6	2	5	
				1				1		1							1				1		1							1				1		1	
			1			1				1						1			1				1						1			1				1	
							1	1		1										1	1		1										1	1		1	
12	1	22	30	24	2	32	34	38	18	70	15	29	10		21	31	24	2	34	35	39	18	72	15	30	10		19	27	23	2	32	33	40	15	68	1
		1						1		1					1						1		1					1						1		1	
		1						1		1					1						1		1					1						1		1	
		1						1		1					1						1		1					1						1		1	
												1													1												
		1	2	1		3				2	2				1	1	1						1	1				1	1	1						1	1
		4	2			1	2	9		8		2																									
							1			1	3																										
			1					6								1					6								1					6			
		4	3			1	3	15		9	3	2				1					6								1					6			
		1						1		1					1						1		1					1						1		1	
		1					1	1							1					1	1							1					1	1			
		1	1	1	1		1		1	1					1	1	1	1		1		1	1					1	1	1	1		1		1	1	
1		1		1											1		1											1		1							
1		2	1	2	1		1		1	1					2	1	2	1		1		1	1					2	1	2	1		1		1	1	

			1	1	1		5	5			6					1	1	1		5	9			6					1
			1	1	2		1	1			7							1						1					1
				[illegible]	[illegible]		6	6			13					1	1	2		5	9			7					2
				1			3				1						1			3				1					1
10	3		8	4	3		2	16	17	4	20		10	3		8	4	3		2	16	17	4	20		10	3		1
					2		2			1	2	1						2		2			1	2	1				1
8	1		1	1	1		3	1	1		2		1							1		1		2					1
2																													
10	1		1	1	1		3	1	1		2		1							1		1		2					1
			1		1		6	1	1	2	2					1		1		6	1	1	2	2					1
	1		1	3	1		1	1		1	5	1		1		1	3	1		1	1		1	5	1		1		1
1			1	1				1	1	1	1		1			1	1				1	1	1	1		1			1
	1		1	4	3		2		6	3	5	2		1		1	4	3		2		6	3	5	2		1		6
											1													1					1
	1		1	4	3		2		6	3	6	2		1		1	4	3		2		6	3	6	2		1		7
	3				2	2		1	3		2	3		3				2	2		1	3		2	3		3		1
			1					1	1							1					1	1							1
	3		1		2	2		2	4		2	3		3		1		2	2		2	4		2	3		3		2
2			1	2	1		2	2	1	1	3		2			1	2	1		2	2	1	1	3		2			2
2	1		1	2	2		3	1	5	1	2	2	2	1		1	2	2		3	1	5	1	2	3	2	1		1
4	1		2	4	3		5	3	6	2	5	2	4	1		2	4	3		5	3	6	2	5	3	4	1		3
					1				1		1							1				1		1					1
				1			1				1						1			1				1					1
								1	1		1										1	1		1					1
25	10		18	21	20	2	31	32	38	14	62	9	16	9		16	19	18	2	28	30	38	14	56	10	15	9		24
			1						1		1																		
			1						1		1																		
			1						1		1																		
1													1													1			1
			1	1	1						1	1				1	1	1						1	1				1
				1					6							1						6							1
				1					6							1						6							1
			1						1		1					1						1		1					1
			1					1	1							1					1	1							1
			1	1	1	1		1		1	1					1	1	1	1		1		1	1					1
			1		1											1		1											1
			2	1	2	1		1		1	1					2	1	2	1		1		1	1					2

CHAPTER III

STAFFING MODELS

An attempt was made to develop staffing models for all of the occupational categories for the various industrial groups using all of the data discussed in Chapter II. Only major industry groups were represented in each of the surveys, and it was necessary to assume that one of the existing sets of data satisfied or described the manpower requirements for the less significant groupings. This was accomplished by selecting one of the models which would provide data most closely approximating the waste characteristics and treatment facilities that would be required in the industry groups for which data were not available.

EPA Models

It was assumed that all of the data collected in the EPA survey were representative of the industrial groups reporting. The reliability of these estimates is directly related to the total number of firms reporting information. The number of firms in each industrial group reporting data in the EPA survey were shown in Table 3 in Chapter II.

Any industrial group having six or more firms reporting probably yields reasonable estimates of the wastewater treatment practices. Obviously, the more firms reporting, the more reliable the calculated mean values are for the various occupational categories.

The mean wastewater discharge flow rate and the average number of employees in the various occupational categories shown in Tables

5-10 were calculated by dividing the total discharge flow and the total number of employees for a particular industrial group by the total number of firms reporting information in the industrial group. The average number of employees in each occupational category varied very little from 1971 through 1976. At first this observation appears to be incorrect, but a more careful analysis of the industries submitting reports shows that the majority of the industries have updated their treatment facilities to meet 1965 standards and could not anticipate the 1972 Amendments to the Federal Water Pollution Control Act. These data still provide a base for projecting the manpower requirements.

EPA is presently promulgating effluent standards for industry and proposing application of these standards to pretreatment and discharge to municipal sewers. The public hearings on the proposed toxic pollution effluent standards have recently begun and promulgation is expected later this year. In most cases the full effects of the industrial effluent limitations, their application to pretreatment, and the toxic regulations can be better predicted after the regulations are promulgated in final form. In the interim, however, reasonable estimates can be made.

The average number employed in the various occupational categories do not differ from year to year within a particular industrial group; however, there is a significant variation in the requirements for various types of manpower between the various industrial groups. Apparently

Table 5. The average number of employees by occupational category employeed in wastewater treatment by various industrial groups during 1971.

SIC Code	Industry Group	Mean Dis-charge Flow, MGD	Average Number Employeed During 1971												
			Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.49	0.67	0.34	0.17	0.55	0.54	0.82	0.17	1.20	0.36	0.73	0.22	0.25
22	Textile Mill Products	0.48	0.13	0.13	0.13	0	0.38	0	0.13	0.25	1.00	0	0.13	0	1.25
24	Lumber & Wood Products	0.024	0	0	0	0	0	0	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	1.00	1.04	0.35	0.04	1.22	1.09	1.61	0.57	1.52	0.70	0.30	0.35	0
28	Chemicals & Allied Products	5.68	0.95	1.39	0.91	0.13	1.35	1.16	1.84	0.60	2.35	0.68	0.81	0.45	0.20
29	Petroleum & Coal Products	0.99	1.11	1.00	0.89	0	1.89	1.11	2.22	0.44	3.78	1.56	3.00	0.78	0.33
30	Rubber & Plastics Products	0.073	0.56	0.22	0.11	0.11	0.11	0.22	0	0	0.78	0.11	0.22	0	0
32	Stone, Clay & Glass Products	0.23	1.00	0.50	0	0	0.50	0	1.00	1.00	0.50	0	0	0	1.50
33	Primary Metals Industry	0.30	0.63	0.81	0.72	0.05	0.91	0.91	0.88	0.42	1.77	0.35	0.67	0.28	0.02
34	Fabricated Metal Products	0.028	0.50	0.50	0.50	0	0.75	0.50	0.50	0	1.50	1.00	0.50	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	0.50	1.00	0.50	0	1.00	0	0	0	1.00	1.00	0	0	0
37	Transportation Equipment	0.82	0.67	0.50	0	0	0.17	0.67	3.17	0	1.83	0.50	0.33	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

Table 6. The average number of employees by occupational category employeed in wastewater treatment by various industrial groups during 1972.

SIC Code	Industry Group	Mean Dis-charge Flow, MGD	Average Number Employeed During 1972												
			Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.49	0.60	0.32	0.22	0.54	0.63	0.77	0.16	1.21	0.59	0.54	0.19	0.26
22	Textile Mill Products	0.48	0.17	0	0.17	0	0.50	0	0.17	0.17	1.17	0	0.17	0	0.83
24	Lumber & Wood Products	0.024	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	0.79	0.93	0.43	0	1.21	0.64	1.79	0.57	2.21	0.64	0.29	0.21	0
28	Chemicals & Allied Products	5.68	0.97	1.42	0.85	0.08	1.44	1.19	1.75	0.62	2.44	0.61	0.86	0.45	0.22
29	Petroleum & Coal Products	0.99	1.14	0.86	0.86	0	1.57	1.43	2.86	0.57	4.29	0	3.86	0.71	0.14
30	Rubber & Plastics Products	0.073	0.43	0.29	0.14	0	0.14	0.29	0	0	0.71	0	0.29	0	0
32	Stone, Clay, & Glass Products	0.23	1.00	0.50	0	0	0.50	0	1.00	1.00	0.50	0	0	0	1.50
33	Primary Metals Industry	0.30	0.63	0.86	0.69	0.06	0.91	0.97	1.09	0.51	2.00	0.43	0.83	0.29	0
34	Fabricated Metal Products	0.028	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	0.50	1.00	0.50	0	1.50	0	0	0	1.00	1.00	0	0	0
37	Transportation Equipment	0.82	0.80	0.60	0	0	0.20	0.60	3.00	0	1.80	0.60	0.40	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

Table 7. The average number of employees by occupational category employed in wastewater treatment by various industrial groups during 1973.

SIC Code	Industry Group	Mean Discharge Flow, MGD	Average Number Employed During 1973												
			Superintendent	Engineer/ Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator/ Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.53	0.63	0.38	0.20	0.49	0.68	0.77	0.17	1.20	0.70	0.60	0.16	0.24
22	Textile Mill Products	0.48	0.33	0.33	0.17	0	0.50	0	0.17	0.17	1.33	0	0.17	0	0.83
24	Lumber & Wood Products	0.024	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	0.85	0.85	0.38	0	1.00	0.46	1.15	0.46	2.08	0.69	0.31	0.15	0
28	Chemicals & Allied Products	5.68	1.01	1.51	0.88	0.09	1.52	1.30	2.06	0.73	2.64	0.67	0.93	0.48	0.24
29	Petroleum & Coal Products	0.99	1.20	0.80	0.80	0	1.80	1.80	3.80	0.80	5.80	0	5.40	0.80	0.20
30	Rubber & Plastics Products	0.073	0.50	0.33	0.17	0	0.17	0.33	0	0	0.83	0	0.33	0	0
32	Stone, Clay, & Glass Products	0.23	1.00	1.00	0	0	0	0	2.00	0	1.00	0	0	0	0
33	Primary Metals Industry	0.30	0.64	0.94	0.73	0.06	1.03	1.06	1.18	0.55	2.18	0.45	0.91	0.30	0
34	Fabricated Metal Products	0.028	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	1.00	1.00	1.00	0	0	0	0	0	1.00	1.00	0	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

Table 8. The average number of employees by occupational categor · employeed in wastewater treatment by various industrial groups during 1974

SIC Code	Industry Group	Mean Dis-charge Flow, MGD	Average Number Employeed During 1974												
			Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.51	0.61	0.33	0.21	0.50	0.67	0.80	0.17	1.15	0.67	0.60	0.16	0.22
22	Textile Mill Products	0.48	0.33	0.17	0.17	0	0.50	0	0.17	0.17	1.33	0	0.17	0	0.83
24	Lumber & Wood Products	0.024	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	0.73	0.82	0.45	0	0.73	0.55	1.73	0.55	2.27	0.82	0.36	0.18	0
28	Chemicals & Allied Products	5.68	1.00	1.49	0.90	0.08	1.54	1.34	2.19	0.75	2.63	0.71	0.92	0.48	0.25
29	Petroleum & Coal Products	0.99	1.20	0.80	0.80	0	1.80	1.80	3.60	0.80	5.80	0	5.20	0.60	0.20
30	Rubber & Plastics Productr	0.073	0.50	0.33	0.17	0	0.17	0.33	0	0	0.83	0	0.33	0	0
32	Stone, Clay, & Glass Products	0.23	1.00	1.00	0	0	0	0	2.00	0	1.00	0	0	0	0
33	Primary Metals Industry	0.30	0.63	0.90	0.77	0.07	1.07	1.10	1.33	0.50	2.27	0.40	0.83	0.33	0
34	Fabricated Metal Products	0.028	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	1.00	1.00	1.00	0	0	0	0	0	1.00	1.00	0	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

Table 9. The average number of employees by occupational category employeed in wastewater treatment by various industrial groups during 1975.

SIC Code	Industry Group	Mean Dis-charge Flow, MGD	Average Number Employeed During 1975												
			Superintendent	Engineer/ Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator/ Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.51	0.63	0.31	0.23	0.49	0.68	0.84	0.18	1.16	0.70	0.64	0.18	0.21
22	Textile Mill Products	0.48	0.33	0.17	0.17	0	0.50	0	0.17	0.17	1.33	0	0.17	0	0.83
24	Lumber & Wood Products	0.024	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	0.70	0.80	0.40	0	0.70	0.60	1.80	0.50	2.40	0.90	0.40	0.10	0
28	Chemicals & Allied Products	5.68	1.06	1.52	0.94	0.09	1.57	1.37	2.24	0.77	2.67	0.73	0.92	0.48	0.25
29	Petroleum & Coal Products	0.99	1.20	0.80	0.80	0	1.80	1.80	3.60	0.80	5.80	0	5.20	0.60	0.20
30	Rubber & Plastic Products	0.073	0.50	0.33	0.17	0	0.17	0.33	0	0	0.83	0	0.33	0	0
32	Stone, Clay, & Glass Products	0.23	1.00	1.00	0	0	0	0	2.00	0	1.00	0	0	0	0
33	Primary Metals Industry	0.30	0.64	0.75	0.71	0.07	1.14	1.14	1.36	0.50	2.21	0.32	0.57	0.32	0
34	Fabricated Metal Products	0.028	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	1.00	1.00	1.00	0	0	0	0	0	1.00	1.00	0	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

Table 10. The average number of employees by occupational category employeed in wastewater treatment by various industrial groups during 1976.

SIC Code	Industry Group	Mean Dis-charge Flow, MGD	Average Number Employeed During 1976												
			Superintendent	Engineer/ Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator/ Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	Food & Kindred Products	0.69	0.53	0.62	0.32	0.23	0.49	0.68	0.85	0.17	1.15	0.70	0.63	0.17	0.21
22	Textile Mill Products	0.48	0.33	0.17	0.17	0	0.50	0	0.17	0.17	1.33	0	0.17	0	0.83
24	Lumber & Wood Products	0.024	0	0.50	0	0	0	0.50	0	0	0	0	0	0	0.50
26	Paper & Allied Products	0.91	0.70	0.80	0.40	0	0.70	0.60	1.80	0.50	2.40	0.90	0.40	0.10	0
28	Chemicals & Allied Products	5.68	1.01	1.52	0.96	0.09	1.59	1.36	2.26	0.77	2.68	0.72	0.92	0.48	0.24
29	Petroleum & Coal Products	0.99	1.20	0.80	0.80	0	1.80	1.80	3.40	0.80	5.80	0	5.20	0.60	0.20
30	Rubber & Plastics Products	0.073	0.50	0.33	0.17	0	0.17	0.33	0	0	0.83	0	0.33	0	0
32	Stone, Clay, & Glass Products	0.23	1.00	1.00	0	0	0	0	2.00	0	1.00	0	0	0	0
33	Primary Metals Industry	0.30	0.62	0.73	0.69	0.08	1.08	1.15	1.46	0.54	2.15	0.38	0.58	0.35	0
34	Fabricated Metal Products	0.028	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0
35	Machinery, Except Electrical	0.0002	0	0	0	0	0	0	0	0	0	0	1.00	0	0
36	Electrical Equip. & Supplies	0.059	1.00	1.00	1.00	0	0	0	0	0	1.00	1.00	0	0	0
38	Instruments & Related Products	0.0003	1.00	0	0	0	0	0	1.00	0	1.00	0	0	0	0

there is no pattern at all when comparing manpower utilization between most of the industrial groups. This lack of uniformity made it very difficult to estimate the requirements for the major industry groups that did not provide data, or provided a very limited amount of data.

To see if a relationship existed between the number of employees engaged in wastewater treatment and the wastewater discharge flow rate, a plot was prepared for each of the major industrial groups providing information. In addition to the relationships developed for the major industrial groups, similar ones were developed for each of the major groups subdivided according to the type of treatment (Table 4) provided for their wastewaters. Both sets of relationships are shown in Figures 1-13.

All of the data were fitted to linear, hyperbolic, and exponential relationships, and if a pattern appeared to exist for a particular set of data, other relationships were tried. With one exception, SIC #33, the primary metals industry, the relationship between waste discharge rate and manpower needs was described best by a simple linear relationship. With the primary metals industry (SIC #33), it was found that a log-log plot of the data gave essentially the same relationship as that provided by the linear plot. However, because the linear relationship yielded a slightly higher correlation coefficient, the information provided by the linear model was employed in making predictions for the total number of employees.

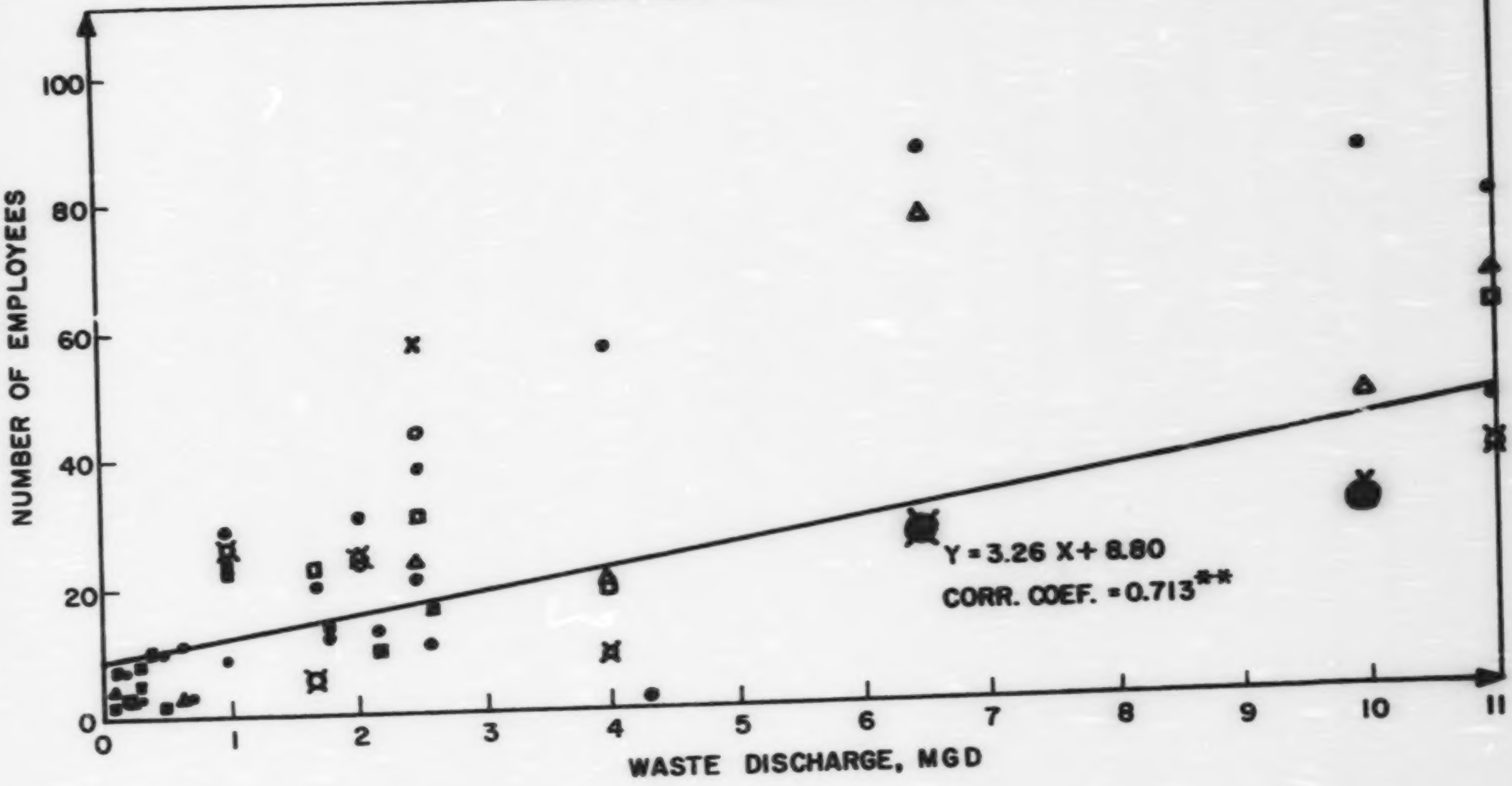


Figure 1. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the food and kindred products industries (SIC #20) (Environmental Protection Agency, 1971).

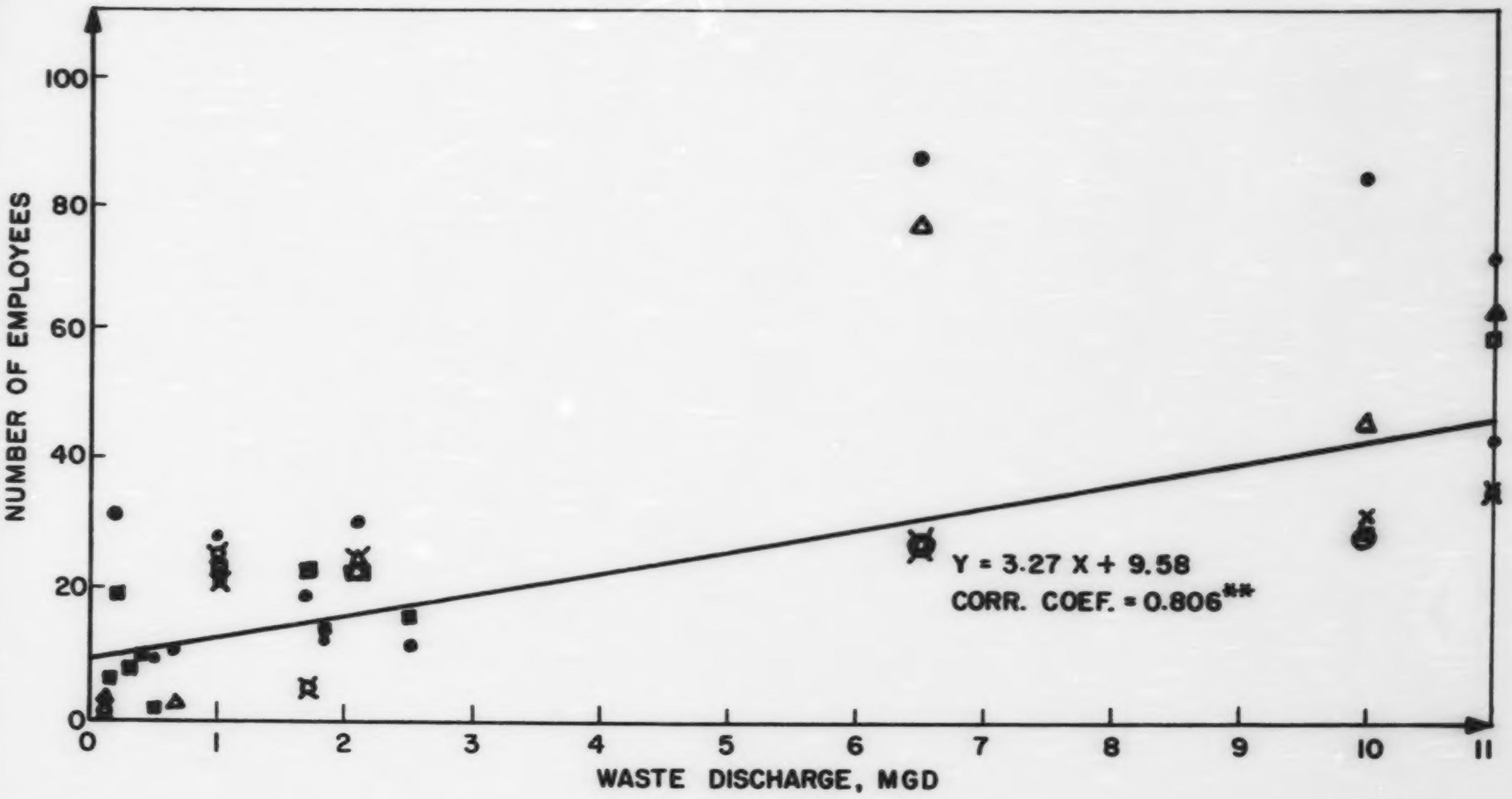


Figure 2. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the food and kindred products industries (SIC #20) using some form of pretreatment and discharge to the municipal sewer (Environmental Protection Agency, 1971).

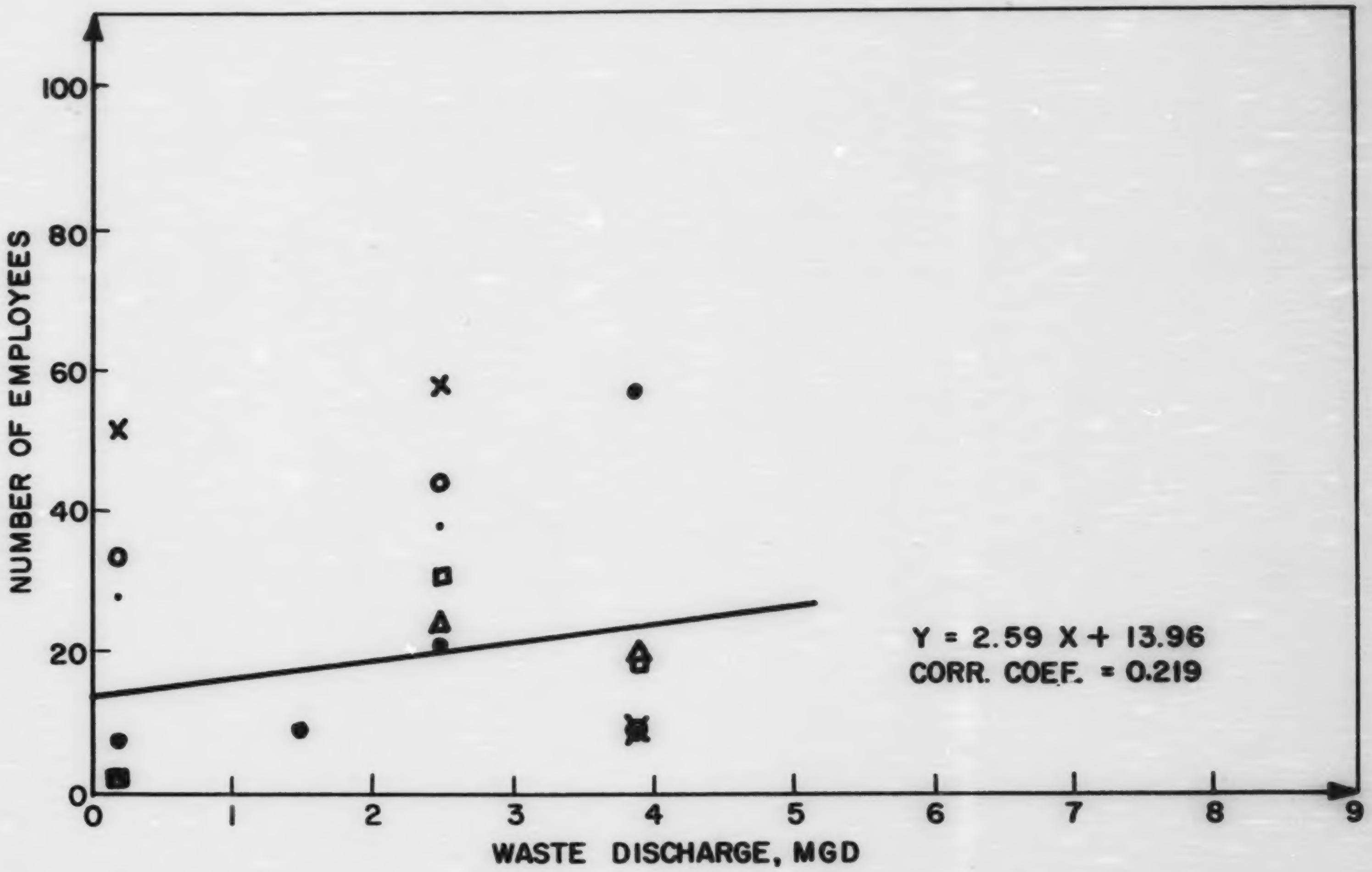


Figure 3. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the food and kindred products industries (SIC #20) using surface, or spray, irrigation disposal techniques (Environmental Protection Agency, 1971).

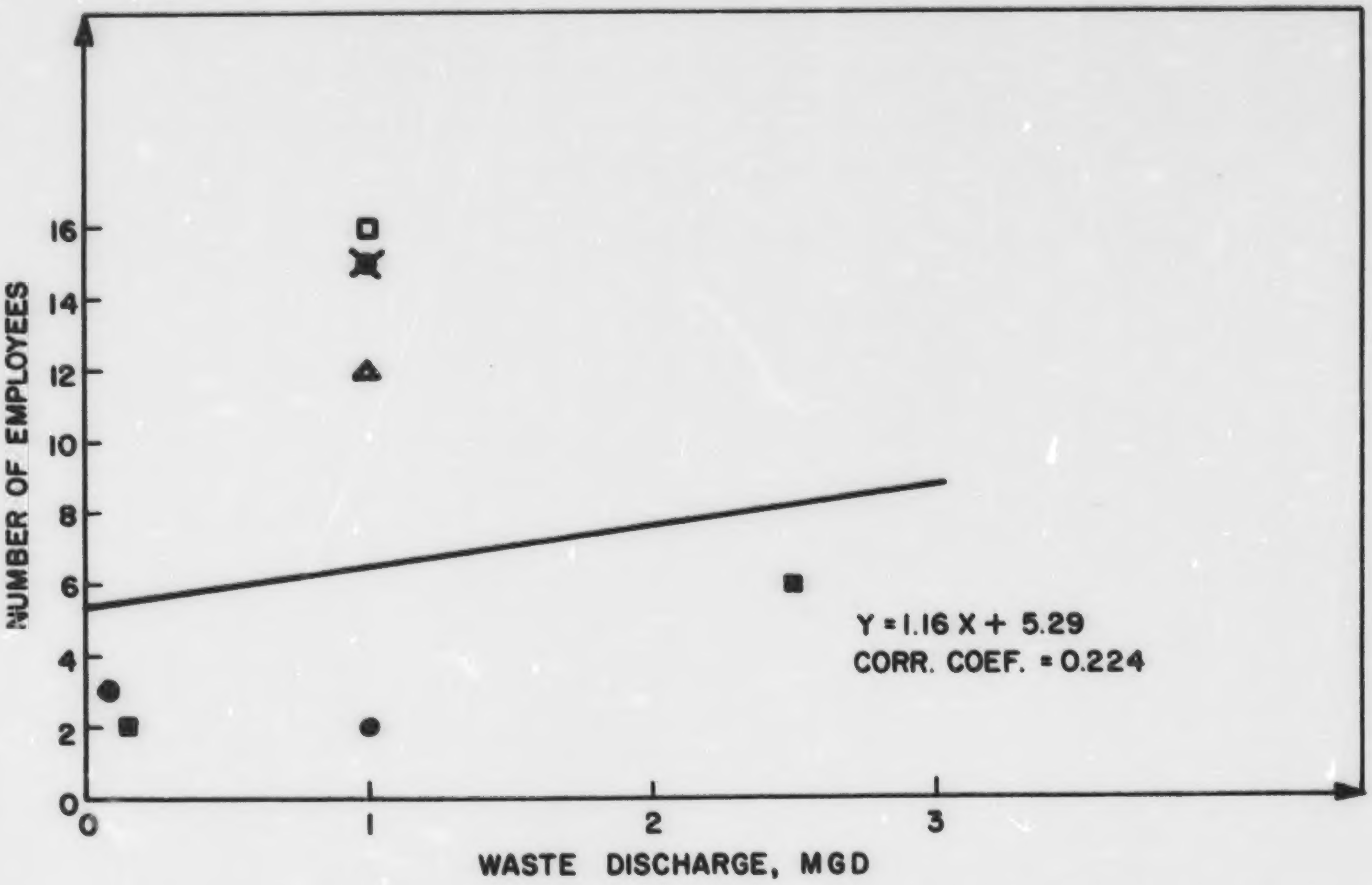


Figure 4. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the textile mill products industries (SIC #22) (Environmental Protection Agency, 1971).

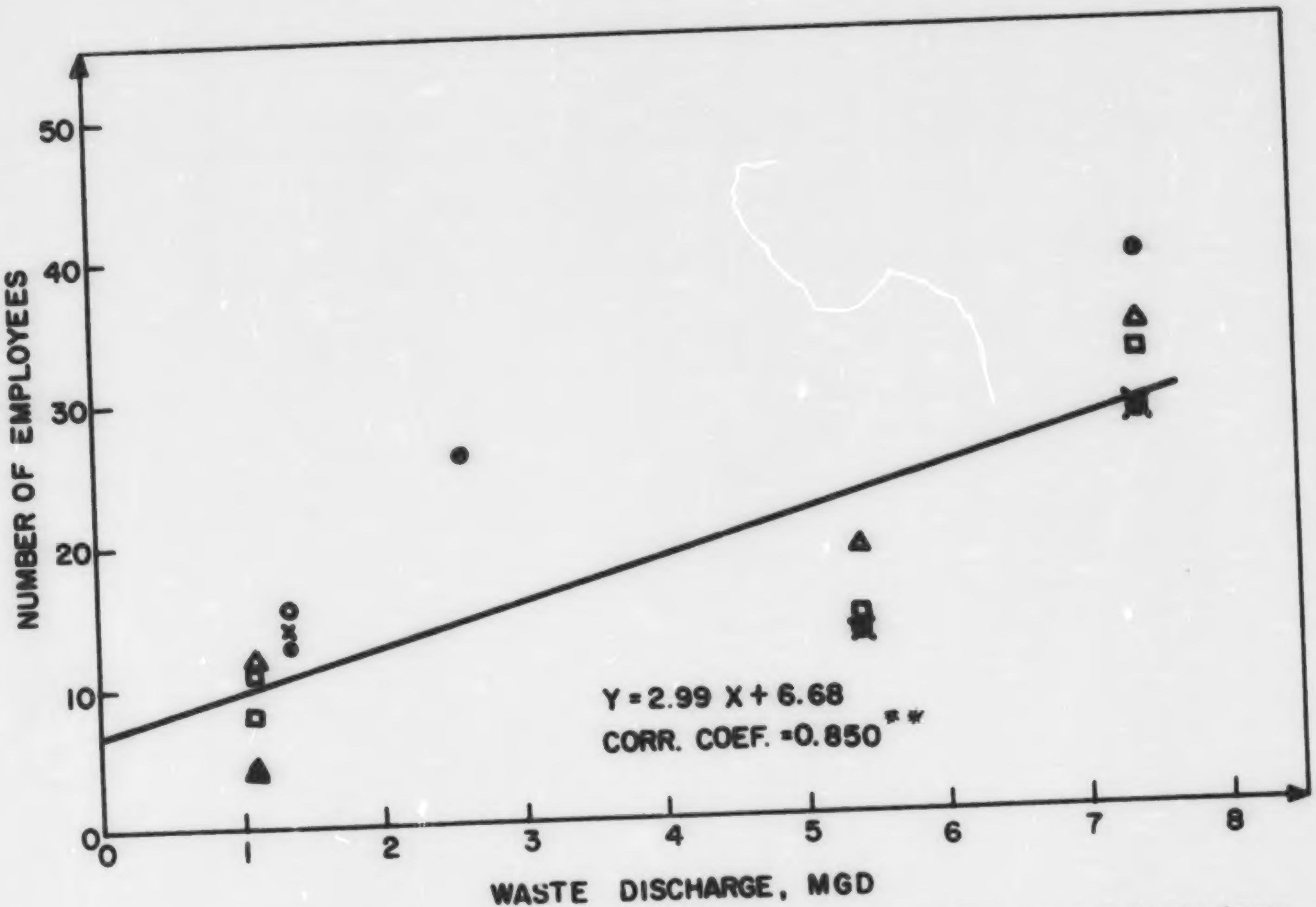


Figure 5. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the paper and allied products industries (SIC #26) using some form of pretreatment and discharge to the municipal sewer (Environmental Protection Agency, 1971).

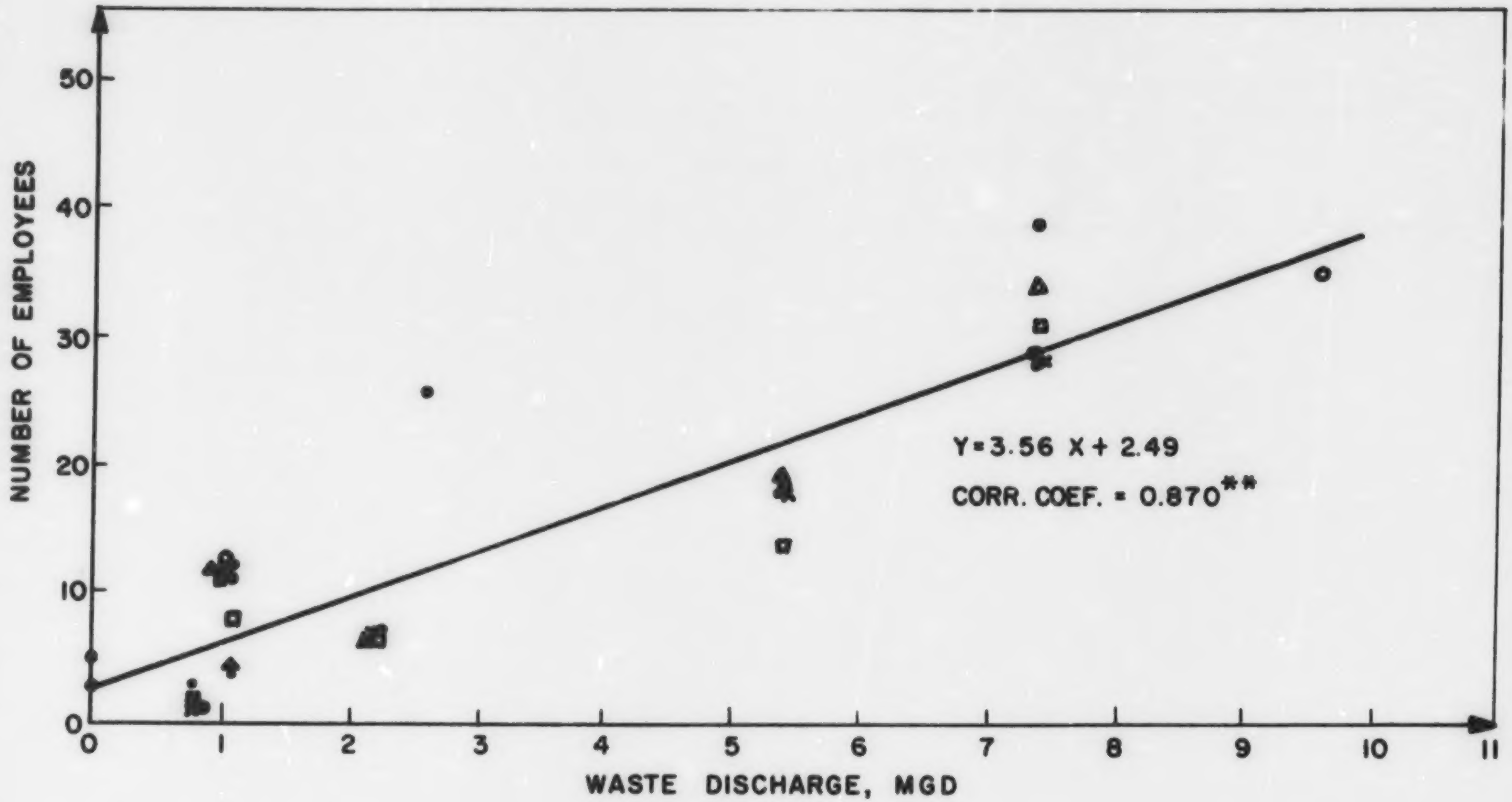


Figure 6. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the paper and allied products industries (SIC #26) (Environmental Protection Agency, 1971).

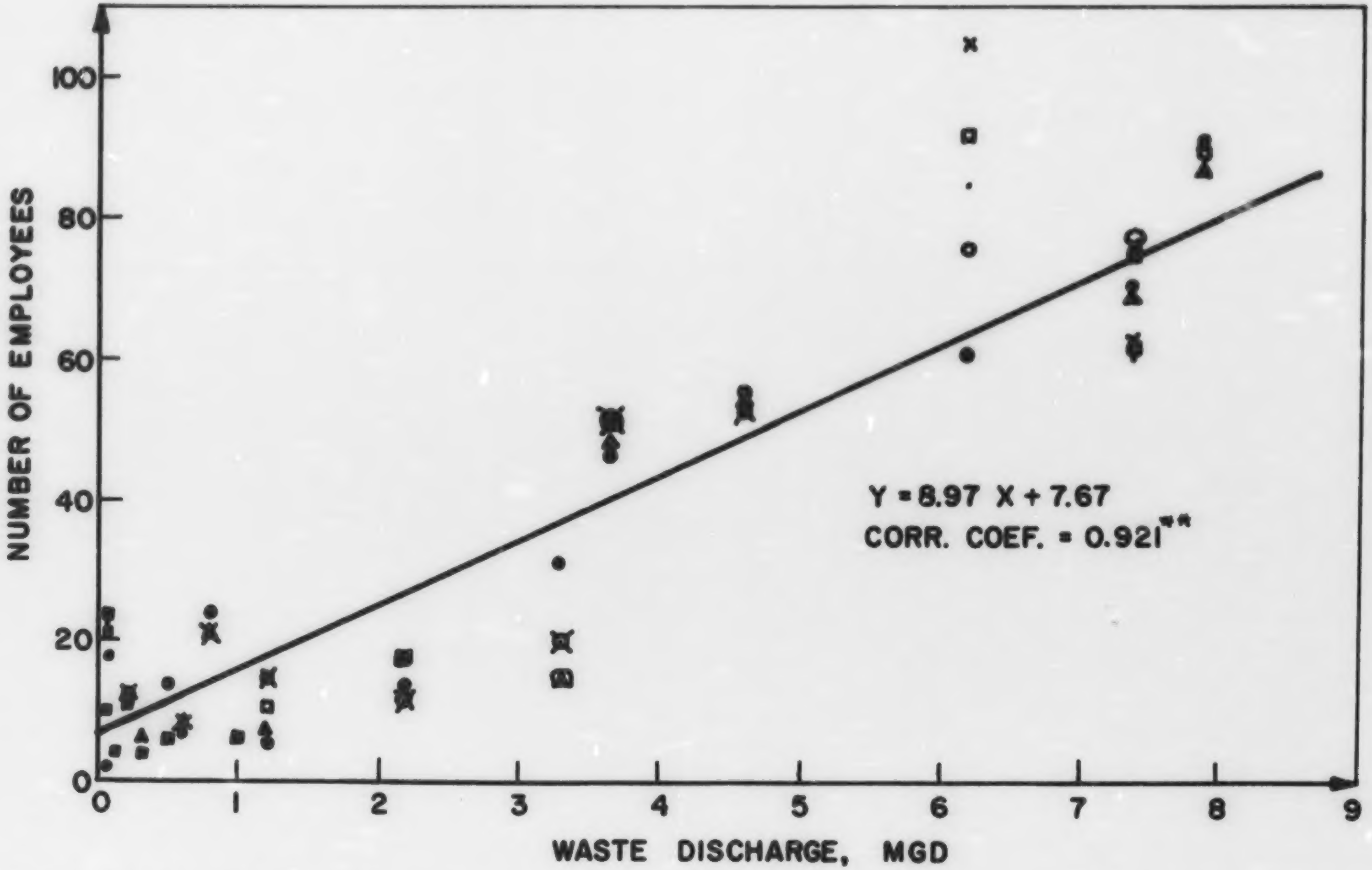


Figure 7. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the chemicals and allied products industries (SIC #28) (Environmental Protection Agency, 1971).

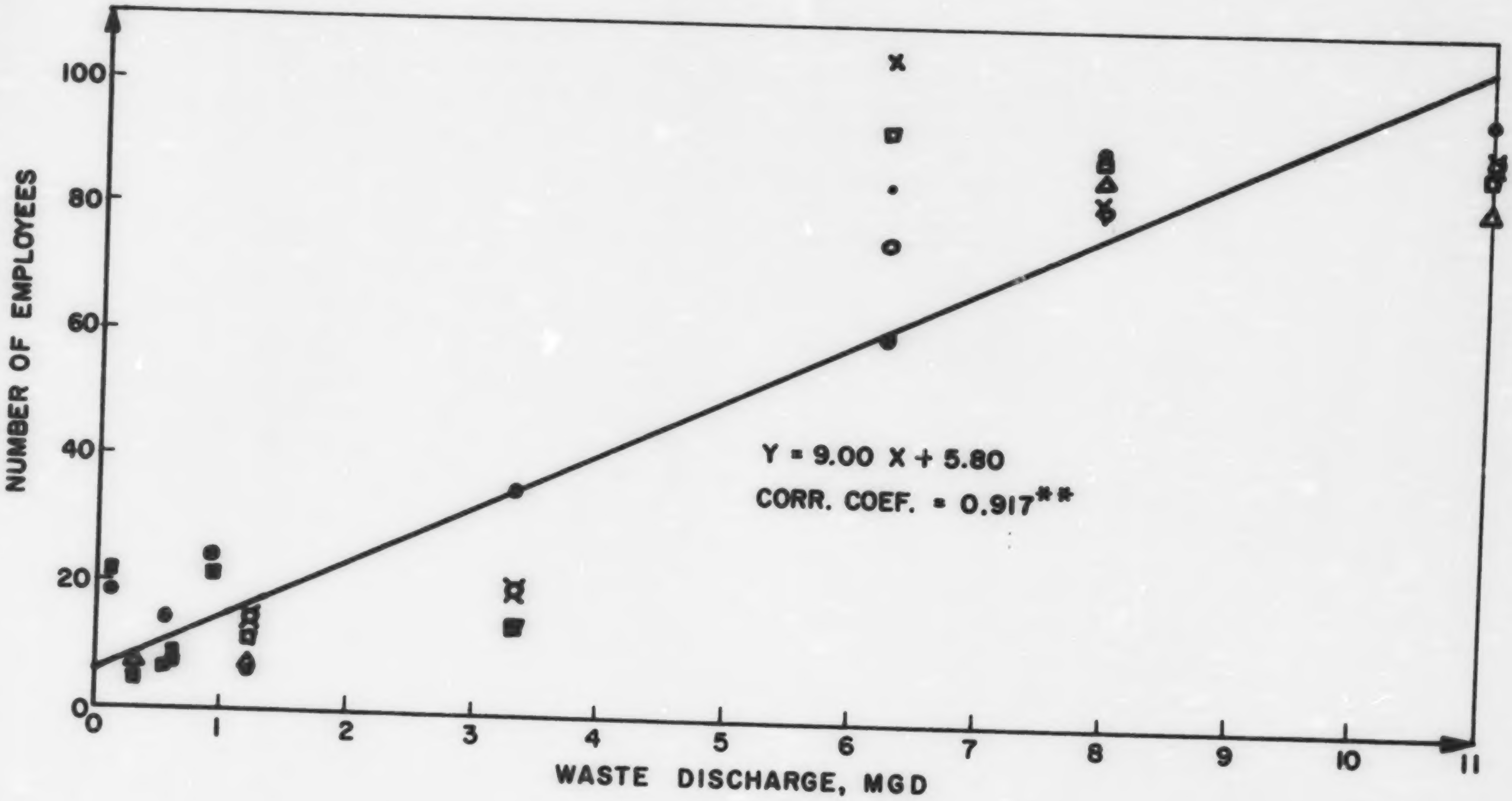


Figure 8. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the chemicals and allied products industries (SIC #28) using some form of pretreatment and discharge to the municipal sewer (Environmental Protection Agency, 1971).

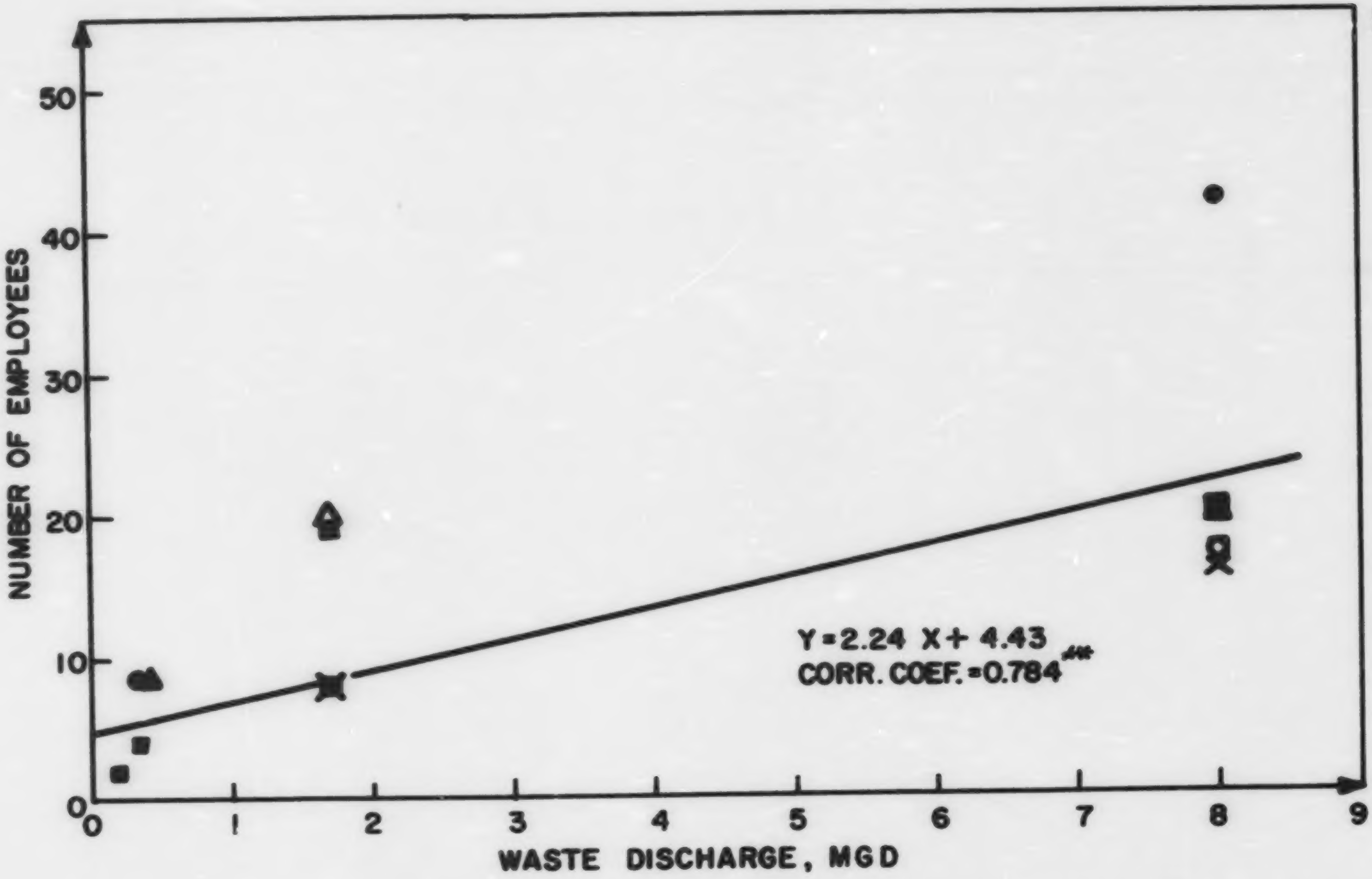


Figure 9. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the petroleum and coal products (SIC #29), rubber and plastic products (SIC #30), and the stone, clay, and glass products (SIC #32) industries (Environmental Protection Agency, 1971).

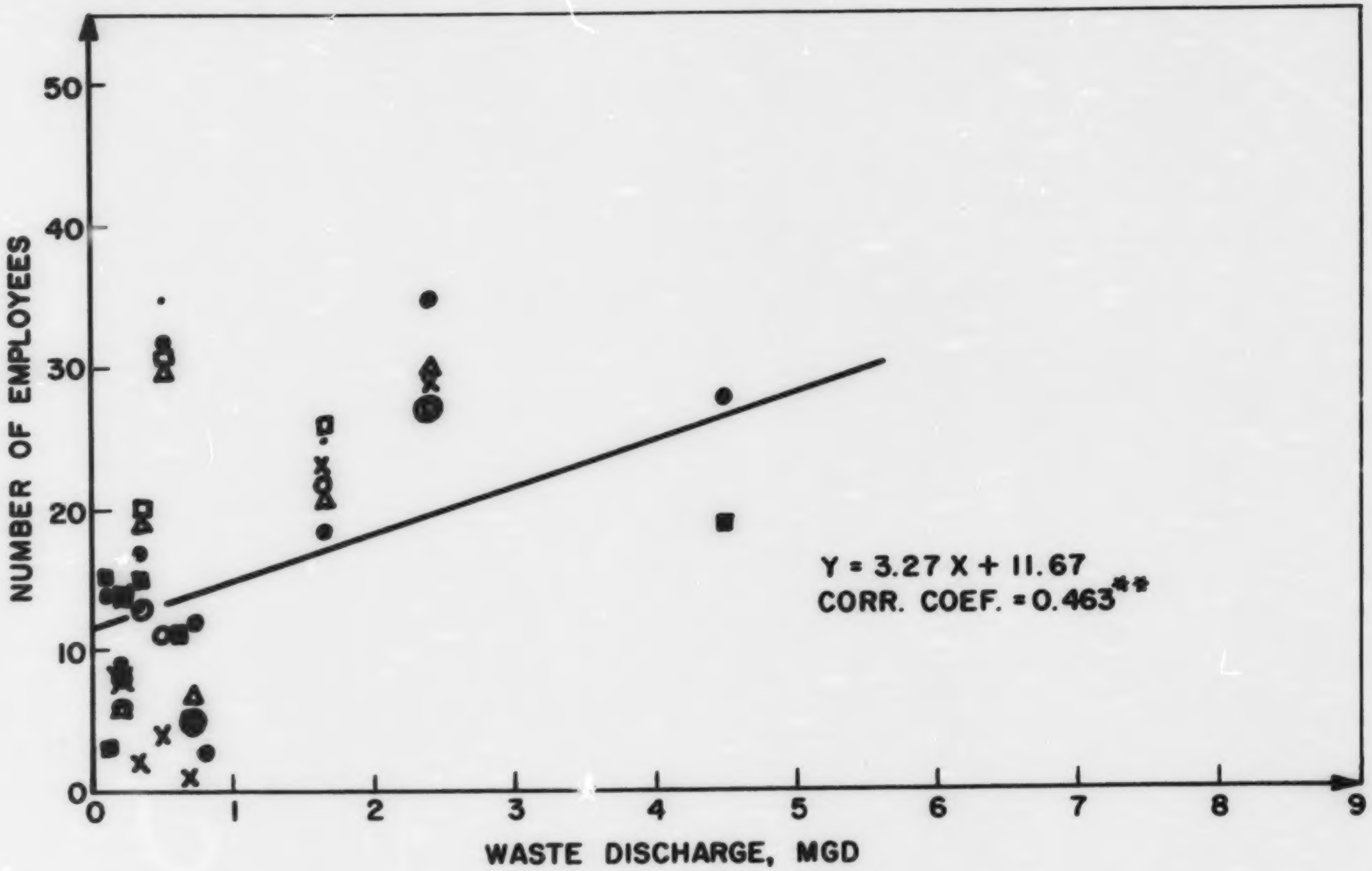


Figure 10. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the primary metals industries (SIC #33) (Environmental Protection Agency, 1971).

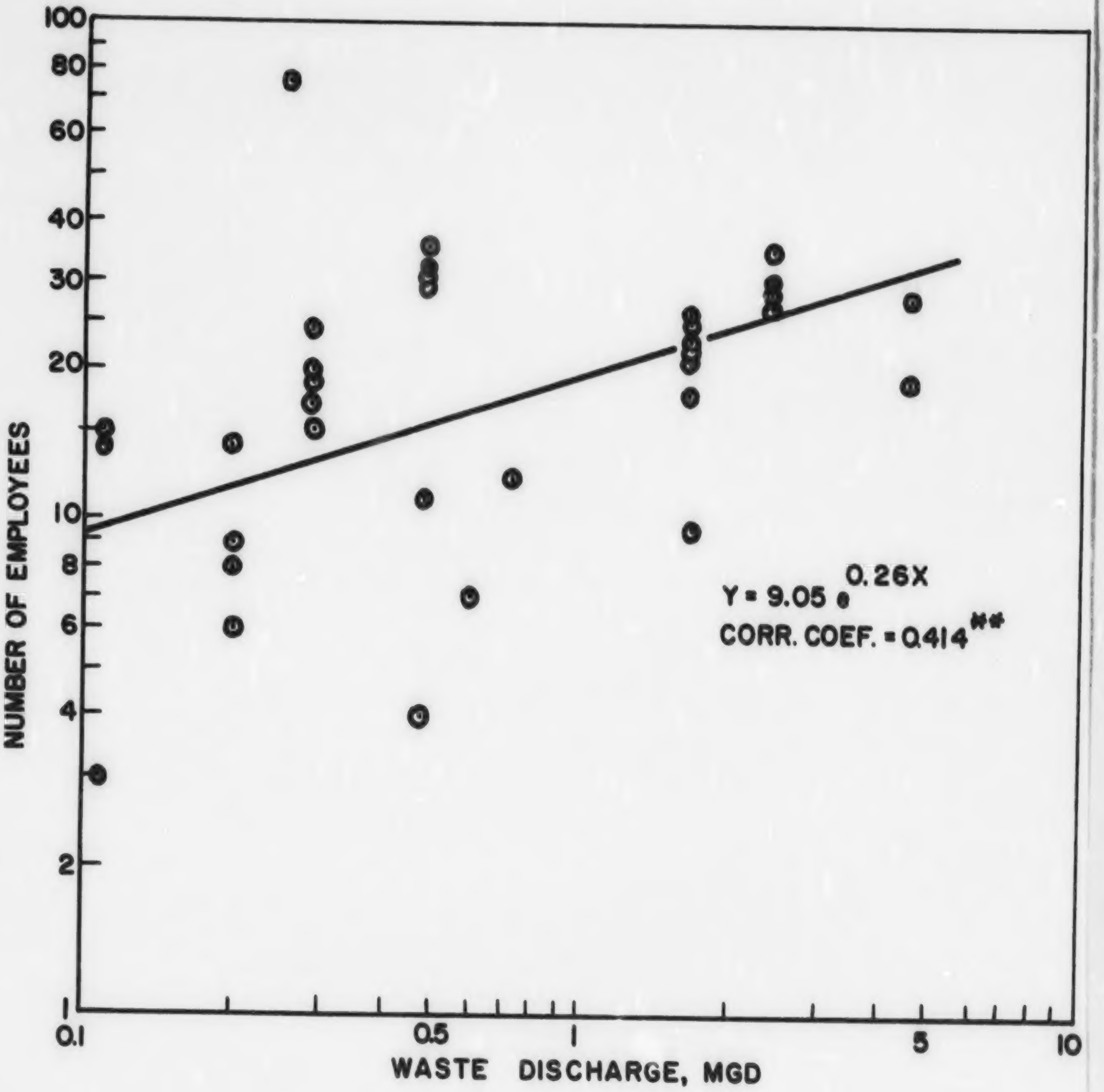


Figure 11. A log-log plot of the number of employees versus the wastewater discharge rate for the primary metals industry (SIC #33) (Environmental Protection Agency, 1971).

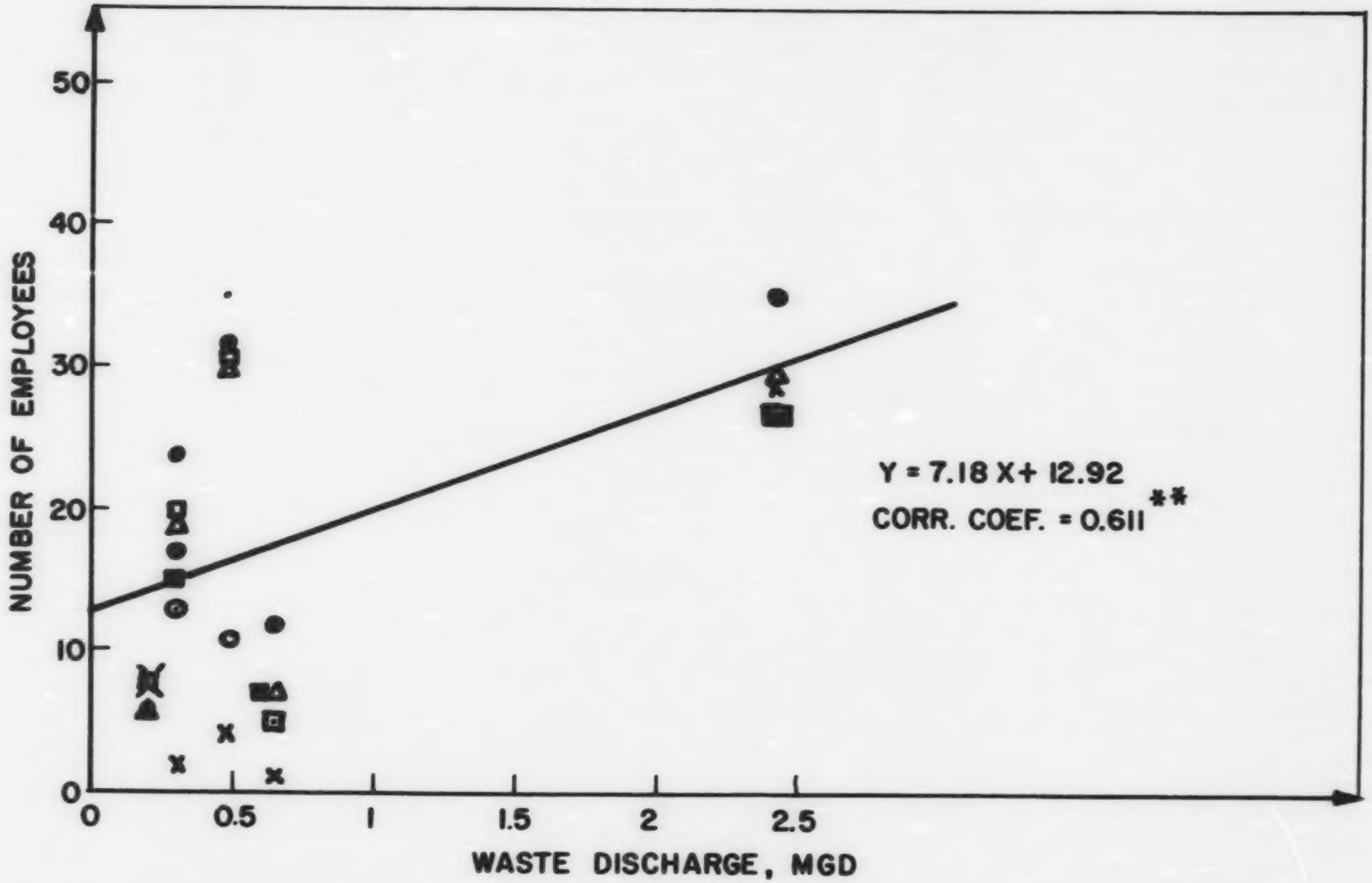


Figure 12. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the primary metals industries (SIC #33) using some form of pretreatment and discharge to the municipal sewer (Environmental Protection Agency, 1971).

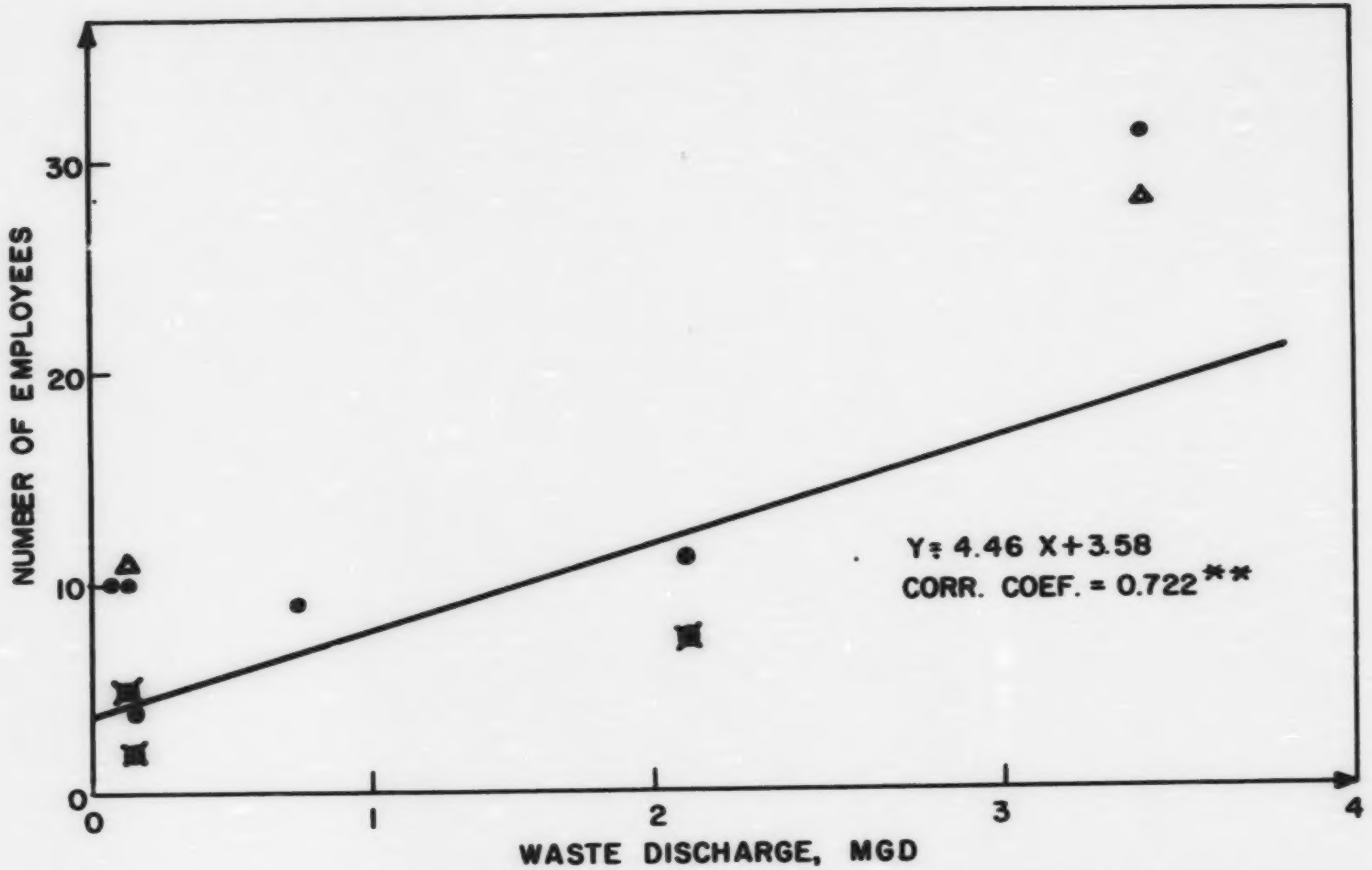


Figure 13. The variation in the number of employees engaged in wastewater treatment with the discharge rate for the fabricated metal products (SIC #34); electrical equipment and supplies (SIC #36); transportation equipment (SIC #37); electric, gas, and sanitary services (SIC #49); and wholesale trade, durable goods (SIC #50) (Environmental Protection Agency, 1971).

There appeared to be very little difference between the number of employees required in the various years, and plots of the discharge rate versus the number of employees by individual year did not provide a better relationship than that obtained when all of the years were grouped. The different symbols shown on the figures represent the various years that the data were reported. The large solid circles represent data for the year 1971; the triangles, 1972; the squares, 1973, the small solid circles, 1974; the circles, 1975; and the x's, 1976.

Figures 1-17 showing the variation in the number of employees versus the discharge rate for the major industrial categories and the various types of treatment employed also show a regression equation expressing the number of employees required for a particular discharge rate. The correlation coefficient for the line of best fit shown on each figure is also reported. The correlation coefficients identified with one asterisk indicates that the relationship is significant at the 5 percent level and the ones with two asterisks indicate that the relationship is significant at the 1 percent level of significance. All of the major SIC category plots of the number of employees versus the waste discharge flow rate were significant at the 1 percent level with the exception being the data plotted for the textile mill products industries (SIC #22). There was a very limited amount of data available for the textile mill products industry in the EPA survey; therefore, it is not surprising that a better relationship was not obtained. However, because of the absence of a better relationship, the model was used in making predictions.

Since the data were quite limited for several of the SIC categories, several plots were made combining various SIC categories to obtain a more representative plot. Where these data were combined a much better relationship was provided than would have been obtained had each of the SIC categories been plotted individually. The validity of combining these various data is questionable, but in view of the limited amount of information available, it appeared more expedient to approach a solution to the problem in this manner than to use a poorly fitted equation to describe the industry.

ESSC Models

Staffing models for the number employed and full-time equivalent employees by occupational category engaged in wastewater treatment plants of various waste discharge rates in the following major SIC industry group categories are summarized in Tables 11 through 17: Food and kindred products (SIC #20), textile mill products (SIC #22), paper and allied products (SIC #26), chemical and allied products (SIC #28), primary metals (SIC #33), transportation equipment (SIC #37), and metal finishing. Again it was necessary, when calculating the average staffing by occupational category for a particular industry, to employ one of the models which appeared to most closely resemble the industries for which data were not available. These estimates are certainly suspect and would lead one to question the total figures provided in the following chapters, except for the particular industries reporting information these models

Table 11. Number employed and full-time equivalent employees by occupational category engaged in was food and kindred products industry (SIC #20) (Environmental Science Services Corporation, 19

Type Plant	Number[a] Employed / Full-time Equivalents Waste Discharge, MGD	Occupational Category							
		Operation		Laboratory				Maintenance	
		Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skille
Food Processing	< 1.0	3 0.8	2 0.5	1 0.3	1 0.1	0 0	0 0	1 0.1	1 0.
Food Processing	1-10	6 1.2	3 0.7	2 0.4	1 0.1	1 0.05	1 0.05	1 0.2	1 0.
Food Processing	> 10	8 2.2	6 1.6	3 0.7	2 0.3	1 0.1	1 0.1	3 0.5	2 0.
Meat & Poultry Packing	All sizes	1 0.1	0 0	0 0	0 0	0 0	0 0	1 0.1	0

[a] Estimated from shift information.

ional category engaged in wastewater treatment plants of various waste discharge rates in the
nce Services Corporation, 1968).

Occupational Category										Total	FTE Number Employed %
y		Maintenance		Instruments & Controls		Supervision					
cial uto yses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management			
 0	0 0	1 0.1	1 0.05	1 0.1	0 0	1 0.1	1 0.05	1 0.05	13 2.15	16.5	
 05	1 0.05	1 0.2	1 0.1	1 0.1	1 0.1	1 0.2	1 0.3	1 0.1	21 3.60	17.1	
 1	1 0.1	3 0.5	2 0.3	2 0.3	1 0.1	3 0.5	3 1.0	3 0.3	38 8.0	21.1	
 0	0 0	1 0.1	0 0	0 0	0 0	0 0	0 0	1 0.05	2 0.15	7.5	

Table 12. Number employed and full-time equivalent employees by occupational category engaged in textile mill products industry (SIC #22) (Environmental Science Services Corporation, 1968)

Type Mill	Number Employed Full-time Equivalents Waste Discharge, MGD	Occupational Categ							
		Operation		Laboratory				Maintenan	
		Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Sk
Fiber	< 0.2	1 0.2	1 0.2	1 0.3	1 0.1	1 0.1	1 0.1	1 0.1	2
Fiber	0.2 - 1.0	2 0.3	3 0.3	2 0.2	1 0.2	1 0.2	2 0.1	4 0.2	4
Fiber	> 1.0	6 0.6	4 0.9	4 0.2	1 0.3	1 0.3	4 0.1	6 0.2	7
Textile	< 1.0	1 0.2	1 0.2	1 0.3	1 0.1	1 0.1	1 0.1	1 0.1	2
Textile	1 - 5	2 0.3	3 0.3	2 0.2	1 0.2	1 0.2	2 0.1	4 0.2	4
Textile	> 5	6 0.6	4 0.9	4 0.2	1 0.3	1 0.3	4 0.1	6 0.2	7

egory engaged in wastewater treatment plants of various waste discharge rates in the Corporation, 1968).

Occupational Category								Total	FTE Number Employed %
	Maintenance		Instruments & Controls		Supervision				
esti- tions	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management		
0.1	1 0.1	2 0.3	1 0.1	1 0.2	1 0.1	1 0.2	1 0.1	14 2.1	15.0
0.1	4 0.2	4 0.3	1 0.1	1 0.3	3 0.2	3 0.3	1 0.1	28 2.8	10.0
0.1	6 0.2	7 0.7	2 0.1	2 0.2	1 0.8	1 0.5	1 0.1	40 5.0	12.5
0.1	1 0.1	2 0.3	1 0.1	1 0.2	1 0.1	1 0.2	1 0.1	14 2.1	15.0
0.1	4 0.2	4 0.3	1 0.1	1 0.3	3 0.2	3 0.3	1 0.1	28 2.8	10.0
0.1	6 0.2	7 0.7	2 0.1	2 0.2	1 0.8	1 0.5	1 0.1	40 5.0	12.5

Table 13. Number employed and full-time equivalent employees by occupational category engaged in wastewater tre rates in the paper and allied products industries (SIC #26) (Environmental Science Services Corporation,

Waste Discharge, MGD	Number[a] Employed / Full-time Equivalents	Occupational Category										
		Operation		Laboratory				Maintenance		Instruments & Controls		
		Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Forem
26	Number[a] Employed	10	10	8	0	0	6	0	6	0	3	3
	Full-time Equivalents	3	3	2	0	0	0.6	0	3.3	0	0.30	1.0

[a] Estimated from shift information.

al category engaged in wastewater treatment plants of various waste discharge
mental Science Services Corporation, 1968).

Category									
tenance		Instruments & Controls		Supervision			Total	FTE Number Employeed %
led	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management		
[illegible]	6 3.3	0 0	3 0.30	3 1.0	5 0.6	1 0.02	52 13.82	26.6

Table 14. Number employed and full-time equivalent employees by occupational category engaged in wastewater treatment plants of various waste chemical and allied products industry (SIC #28) (Environmental Science Services Corporation, 1968).

Type Plant	Waste Discharge, MGD (Number Employed / Full-time Equivalents)	Occupational Category											
		Operation		Laboratory				Maintenance		Instruments & Controls		Supervision	
		Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional
Chemical	0.02	1 / 0.07	1 / 0.08	0 / 0	1 / 0.06	0 / 0	0 / 0	1 / 0.03	1 / 0.03	0 / 0.01	1 / 0.01	0 / 0	1 / 0.20
Pharmaceutical	0.58	0 / 0	6 / 3.0	0 / 0	3 / 1.0	1 / 0.05	0 / 0	0 / 0	1 / 0.12	0 / 0	1 / 0.20	0 / 0	1 / 0.25
Chemical-Petrochemical	1.5	4 / 0.35	6 / 3.0	4 / 0.4	1 / 0.03	0 / 0	1 / 0.02	4 / 0.42	4 / 0.30	2 / 0.2	0 / 0	0 / 0	3 / 0.7
Monomer Production	1.5	6 / 3.0	0 / 0	0 / 0	3 / 1.0	3 / 0.5	1 / 0.05	1 / 0.02	1 / 0.10	1 / 0.02	0 / 0	0 / 0	5 / 1.5
Petrochemical	1.75	6 / 2.6	0 / 0	2 / 0.6	0 / 0	2 / 0.5	5 / 2.1	4 / 0.45	4 / 0.54	1 / 0.13	1 / 0.13	1 / 0.2	1 / 0.25
Chemical	3.0	0 / 0	12 / 6	2 / 0.4	1 / 0.1	0 / 0	0 / 0	5 / 0.6	0 / 0	0 / 0	0 / 0	3 / 0.5	6 / 0.6
Refinery	3.02	0 / 0	6 / 0.5	/ 0	3 / 0.17	0 / 0	0 / 0	3 / 0.06	0 / 0	0 / 0	0 / 0	0 / 0	2 / 0.1
Refinery	4.61	0 / 0	10 / 0.75	0 / 0	3 / 0.20	0 / 0	0 / 0	0 / 0	4 / 0.33	0 / 0	0 / 0	0 / 0	3 / 0.26
Refinery	6.15	0 / 0	10 / 2.8	0 / 0	5 / 1.12	0 / 0	0 / 0	12 / 3.5	0 / 0	0 / 0	0 / 0	0 / 0	3 / 0.69
Chemical-Refinery	15.6	7 / 0.7	7 / 0.7	0 / 0	4 / 1.05	3 / 0.35	0 / 0	3 / 0.56	2 / 0.25	3 / 1.05	4 / 0.45	0 / 0	3 / 1.20

---

[a] Estimated from shift information.

tional category engaged in wastewater treatment plants of various waste discharge rates in the
Science Services Corporation, 1968).

Occupational Category									Total	FTE Number Employed %
ory		Maintenance		Instruments & Controls		Supervision				
pecial Auto nalyses	Investi-gations	Unskilled	Skilled	Routine	Install-ation & Maint.	Foreman	Profes-sional	Manage-ment		
0 0	0 0	1 0.03	1 0.03	0 0.01	1 0.01	0 0	1 0.20	1 0.05	8 0.54	6.8
0.05	0 0	0 0	1 0.12	0 0	1 0.20	0 0	1 0.25	1 0.10	14 4.72	33.7
0	1 0.02	4 0.42	4 0.30	2 0.2	0 0	0 0	3 0.7	1 0.10	30 5.52	18.4
0.5	1 0.05	1 0.02	1 0.10	1 0.02	0 0	0 0	5 1.5	1 0.10	22 6.29	28.6
0.5	5 2.1	4 0.45	4 0.54	1 0.13	1 0.13	1 0.2	1 0.25	1 0.10	28 7.60	27.1
0	0 0	5 0.6	0 0	0 0	0 0	3 0.5	6 0.6	1 0.10	30 8.30	27.7
0	0 0	3 0.06	0 0	0 0	0 0	0 0	2 0.1	1 0.04	15 0.87	5.8
0	0 0	0 0	4 0.33	0 0	0 0	0 0	3 0.26	1 0.12	21 1.66	7.9
0	0 0	12 3.5	0 0	0 0	0 0	0 0	3 0.69	3 0.20	33 8.31	25.2
0.35	0 0	3 0.56	2 0.25	3 1.05	4 0.45	0 0	3 1.20	1 0.10	37 6.41	17.3

Table 15. Number employed and full-time equivalent employees by occupational category
rates in the primary metals industries (SIC #33) (Environmental Science Servic

Number Employed Full-time Equivalents Waste Discharge, MGD	Occupational Category								
	Operation		Laboratory				Maintenance		
	Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Rou
4	1 0.2	1 0.4	1 0.2	1 0.05	1 0.05	1 0.1	1 0.2	1 0.1	1 0
4-8	2 0.2	3 0.3	2 0.2	1 0.2	1 0.1	1 0.1	4 0.3	2 0.2	3 0.
> 8	3 0.4	3 0.6	3 0.2	1 0.3	1 0.2	0 0	7 0.8	2 0.3	4 0

yees by occupational category engaged in wastewater treatment plants of various waste discharge (Environmental Science Services Corporation, 1968).

Occupational Category									Totals	FTE Number Employed %
		Maintenance		Instruments & Controls		Supervision				
al o es	Investi-gations	Unskilled	Skilled	Routine	Install-ation & Maint.	Foreman	Profes-sional	Manage-ment		
5	1 0. 1	1 0. 2	1 0. 1	1 0.1	1 0. 1	1 0. 1	1 0. 1	1 0. 1	13 1. 8	13.8
	1 0. 1	4 0. 3	2 0. 2	3 0. 2	1 0. 2	3 0. 2	1 0. 2	1 0. 1	25 2. 5	10.0
2	0 0	7 0. 8	2 0. 3	4 0.4	1 0.4	3 0. 2	1 0. 5	1 0. 1	30 4. 4	14.7

Table 16. Number employed and full-time equivalent employees by occupational category engaged in wast rates in the transportation equipment industries (SIC #37) (Environmental Science Services Co

Number Employed / Full-time Equivalents Waste Discharge, MGD	Occupational Category									
	Operation		Laboratory				Maintenance		Instruments & Controls	
	Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Instal ation Mai
0.08	0 0	1 0.5	0 0	1 0.1	1[a] 0.05[a]	1[a] 0.05[a]	0 0	1 0.1	0 0	1 0.
0.11	0 0	1 0.8	1 0.2	1 0.1	8 0.08	8 0.07	0 0	1 0.2	1 0.15	0
0.50	0 0	1 0.25	0 0	1 0.25	0 0	0 0	0 0	1 0.2	0 0	1 0.
0.50	1 1.0	1 0.25	1 0.1	1 0.1	1 0.05	1 0.05	1 0.1	0 0	1 0.1	1
0.60	0 0	2 1.5	1 0.25	1 0.15	8 0.08	8 0.07	0 0	1 0.3	0 0	1
0.70	1 0.8	2 1.5	1 0.40	1[a] 0.1[a]	1[a] 0.05[a]	1[a] 0.05[a]	1 0.2	2 0.2	2 0.3	0
1.40	1 1.0	5 3.0	5 1.0	1 0.15	1 0.15	1 0.15	5 0.5	0 0	1 0.25	1

[a] Estimated from shift information.

[b] Excludes fourteen people listed under laboratory special and investigative categories.

employees by occupational category engaged in wastewater treatment plants of various waste discharge stries (SIC #37) (Environmental Science Services Corporation, 1968).

Occupational Category									Totals	FTE Number Employed %
ratory		Maintenance		Instruments & Controls		Supervision				
Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management		
1[a] / 0.05[a]	1[a] / 0.05[a]	0 / 0	1 / 0.1	0 / 0	1 / 0.1	0 / 0	1 / 0.2	1 / 0.05	8 / 1.15	14.4
8 / 0.08	8 / 0.07	0 / 0	1 / 0.2	1 / 0.15	0 / 0	0 / 0	1 / 0.25	1 / 0.10	23 / 1.77	19.7[b]
0 / 0	0 / 0	0 / 0	1 / 0.2	0 / 0	1 / 0.05	0 / 0	1 / 0.05	0 / 0	5 / 0.80	16.0
1 / 0.05	1 / 0.05	1 / 0.1	0 / 0	1 / 0.1	1 / 0.05	1 / 0.05	1 / 0.05	1 / 0.10	12 / 2.00	16.7
8 / 0.08	8 / 0.07	0 / 0	1 / 0.3	0 / 0	1 / 0.1	0 / 0	1 / 0.3	1 / 0.10	24 / 2.85	28.5[b]
1[a] / 0.05[a]	1[a] / 0.05[a]	1 / 0.2	2 / 0.2	2 / 0.3	0 / 0	1 / 0.1	0 / 0	1 / 0.05	14 / 3.75	26.8
1 / 0.15	1 / 0.15	5 / 0.5	0 / 0	1 / 0.25	1 / 0.10	1 / 0.6	1 / 0.8	1 / 0.3	24 / 8.00	33.3

atory special and investigative categories.

Table 17. Number employed and full-time equivalent employees by occupational category engaged in wastewater treatment plants of various waste rates in the metal finishing industry (Environmental Science Services Corporation, 1968).

Number[a] Employed Full-time Equivalents Waste Discharge, MGD	Occupational Category													Totals
	Operational		Laboratory				Maintenance		Instruments & Controls		Supervision			
	Unskilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management	
<0.1	1 0.1	1 0.1	1 0.1	1 0.2	0 0	0 0	1 0.1	1 0.2	1 0.05	1 0.1	1 0.1	1 0.1	1 0.05	11 1.2
0.1 - 1.0	2 0.2	2 0.2	2 0.2	1 0.2	0 0	0 0	1 0.2	1 0.2	1 0.1	1 0.1	1 0.1	1 0.1	1 0.1	14 1.7

[a]Estimated from shift information.

equivalent employees by occupational category engaged in wastewater treatment plants of various waste discharge try (Environmental Science Services Corporation, 1968).

Occupational Category										Totals	FTE Number Employed %
Laboratory			Maintenance		Instruments & Controls		Supervision				
Detailed Analyses	Special & Auto Analyses	Investigations	Unskilled	Skilled	Routine	Installation & Maint.	Foreman	Professional	Management		
1 0.2	0 0	0 0	1 0.1	1 0.2	1 0.05	1 0.1	1 0.1	1 0.1	1 0.05	11 1.2	10.9
1 0.2	0 0	0 0	1 0.2	1 0.2	1 0.1	1 0.1	1 0.1	1 0.1	1 0.1	14 1.7	12.1

should be very reliable. The majority of the information collected by the Environmental Science Services Corporation were gathered from firms providing a very high degree of treatment which would probably meet existing standards. Therefore, it appears reasonable to use these models to make estimates of the number of people employed and likely to be needed in the near future.

The ESSC data provided the total number employed as well as the full-time equivalents which made it possible to calculate the percent effort normally devoted by an employee in industry to his wastewater treatment plant duties. This percentage effort varied from a low of 5.8 percent to 33.7 percent with an average value appearing to be approximately 15 percent effort (Tables 11-17).

As a means of checking the models obtained from the EPA data, where information was available, plots of the number of employees versus the waste discharge for the industrial plants surveyed were prepared as described in the EPA survey information above. Unfortunately, the data provided in the ESSC survey were classified in broad groupings for the waste discharge flow rate and this made it possible to make only three comparisons (Figures 14-16). Data were available for the chemical and allied products industry (SIC #28) petroleum and coal products (SIC #29), and the transportation equipment industries (SIC #37). The equation of the line of best fit for the chemical and allied products and the transportation equipment industries were significant statistically

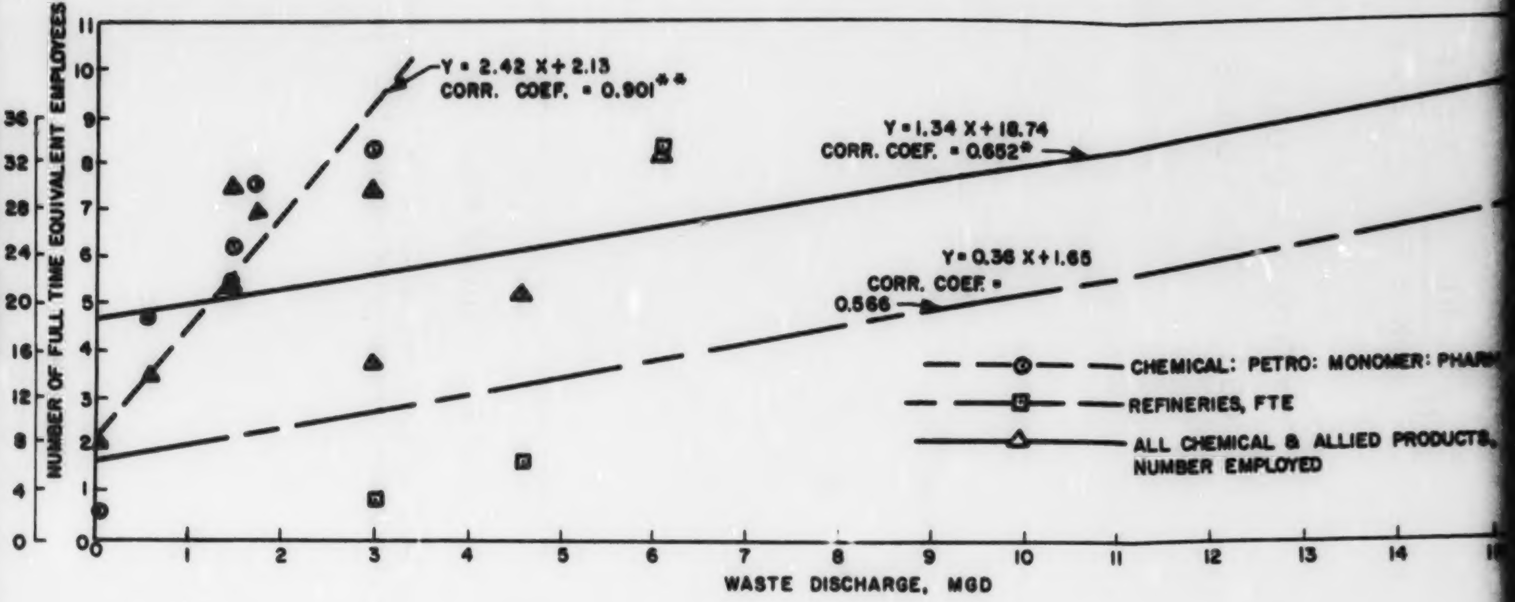
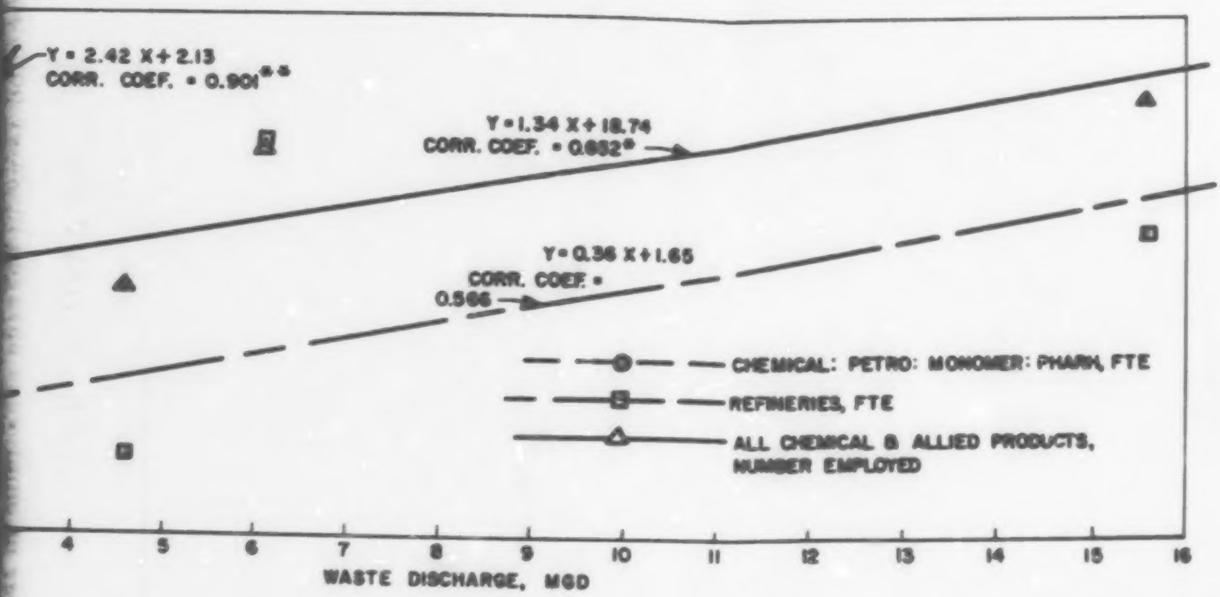


Figure 14. The variation in the number of employees and full-time equivalent employees with the wastewater discharge rate for the chemicals and allied products industry (SIC #28) (Environmental Science Services Corporation, 1968).



and full-time equivalent employees with the wastewater discharge rate for the chemicals and allied
al Science Services Corporation, 1968).

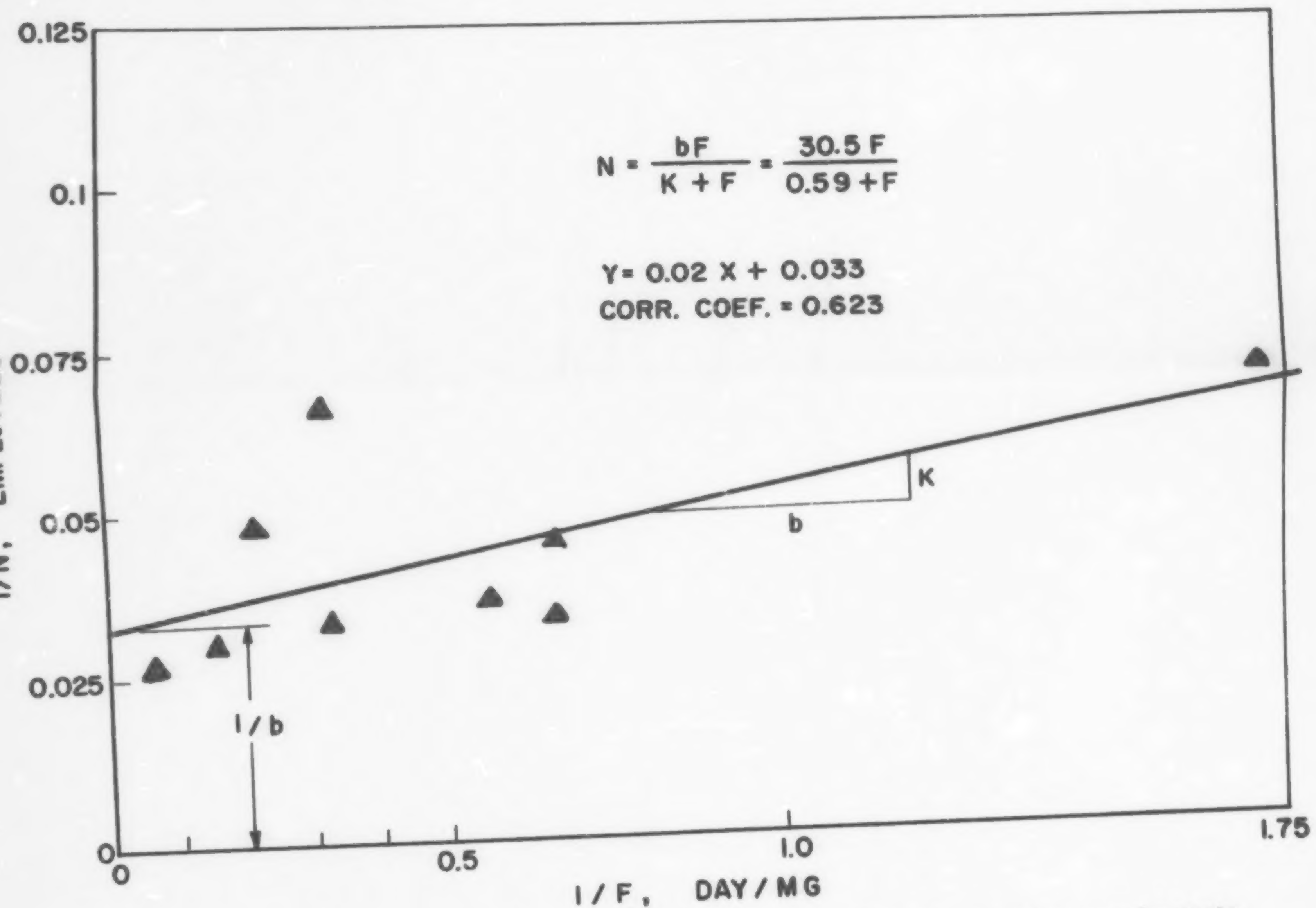


Figure 15. A reciprocal plot of the number of employees engaged in water pollution control versus the waste discharge rate for the chemical and allied products industries (SIC #28) (Environmental Science Services Corporation, 1968).

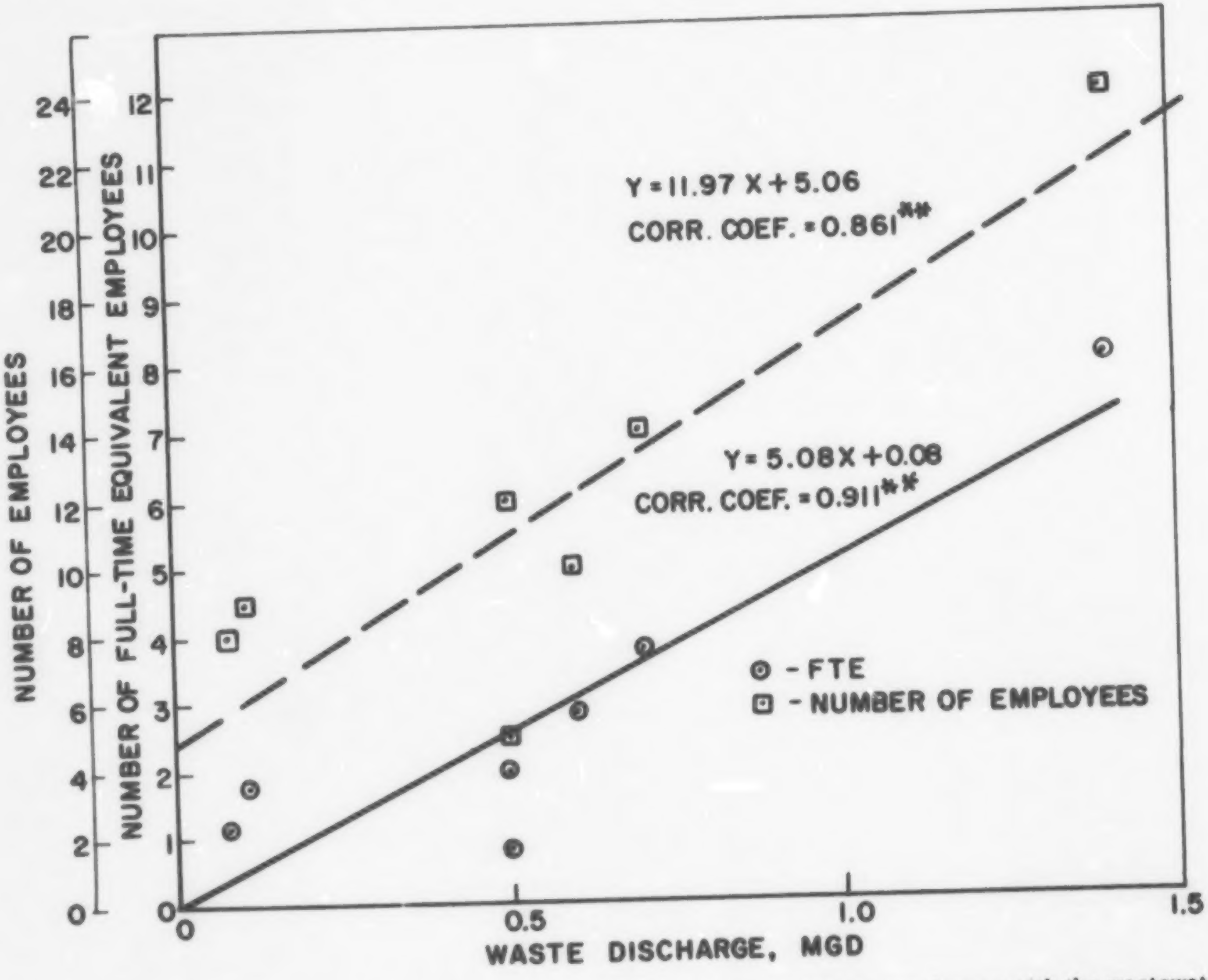


Figure 16. The variation in the number of employees and full-time equivalent employees with the wastewater discharge rate for the transportation equipment industries (SIC #37) (Environmental Science Services Corporation, 1968).

and provided similar information at the low flow rates employed in this study. However, if larger discharge rates were encountered, the predicted manpower needs for the two models would be very different. This discrepancy is attributable to the lack of data in the EPA study for plants discharging large volumes of wastewater.

Insufficient data were collected in the EPA study to prepare a separate model for the petroleum and coal products industry, and it was necessary to prepare a model based on combined data. The EPA and ESSC models for petroleum and coal products (actually refineries in both models) differ greatly. This difference is probably due to the combining of data to obtain the EPA model; however, too little data are available in both cases to select one model over the other. Therefore, the manpower needs were calculated independently for both models.

NUS Corporation Model

From a survey of the economic requirements to meet discharge standards in the inorganic chemical industry, a model of manpower needs for a wastewater treatment plant with a discharge flow rate of approximately 2 mgd was located. This model is presented in Table 18. The values reported agree very well with the model produced both by EPA and the ESSC models. These data were not used further but do serve as a basis to further verify the results obtained in the other two surveys.

Table 18. Full-time equivalent employees by occupational category engaged in a wastewater treatment plant with a discharge flow rate of approximately 2 MGD from an inorganic chemical industry. Equalization, chemical addition, sedimentation, filtration, reverse osmosis, and deep well injection techniques were employed (NUS Corporation, 1969).

Occupational categories	Full-time equivalents employed in wastewater treatment	
Operator	0.96	
Attendant	1.34	
Worker	1.24	
		3.54
Instrument Repairman	0.14	
Water Pump Serviceman	0.32	
Maintenance Mechanic	0.26	
Pipe Fitter, Maintenance	0.14	
Electrician, Maintenance	0.14	
		1.00
Laboratory Technician	0.33	
Technical Management & Services	0.39	
		0.72
Administrative & Support Services	0.41	
		0.41

Models Applied to Subdivisions of Major SIC Categories

All of the manpower models presented so far have been grouped according to major SIC categories only. In an attempt to further break down the manpower needs in the various industrial categories, it was decided to use the major subdivisions within each of the main SIC categories to predict the average number of employees in the various occupational categories. Data taken from the 1968 Census Bureau Study of Manufacturers Using Water were used to establish a mean flow rate in each of the various subcategories of the SIC grouping. The volume of water withdrawn for process purposes by each of the subcategories was used as an estimate for the total volume of wastewater that would be discharged. This value was selected because it is quite likely that the wastewater requiring treatment would result from the water used in process applications. This would exclude all of the cooling water and water used for air conditioning of the buildings, which probably would not flow through the treatment facility. An average discharge flow rate was calculated by dividing the volume of water withdrawn for process use per year by the number of industries reporting data and then dividing by 365 days per year. The average discharge flow rate for the industry subcategories are summarized in Table 19 along with the average number of employees calculated from the models presented in Figures 1 through 13 and Tables 11 through 17.

Table 19. Wastewater treatment manpower requirements per establishment by o
use estimated from both the EPA and ESSC models.

Industry Group and Industry	Establishments Reporting Consumption of Water	Mean Water Intake for Process Use MGD	EPA Models						
				Operation					
				Unskilled		Skilled		Routine	
				Total	FTE	Total	FTE	Total	FTE
Food and Kindred Products	2,345	0.34	9.91	3	0.8	2	0.5	1	0.3
Meat Products	464	0.37	10.01	3	0.8	2	0.5	1	0.3
Dairy Products	518	0.085	9.08	3	0.8	2	0.5	1	0.3
Canned, Cured, and Frozen Foods	448	0.43	10.20	3	0.8	2	0.5	1	0.3
Grain Mill Products	83	0.39	10.07	3	0.8	2	0.5	1	0.3
Bakery Products	65	0.046	8.95	3	0.8	2	0.5	1	0.3
Sugar	127	1.60	14.02	6	1.2	3	0.7	2	0.4
Confectionery and Related Products	39	0.18	9.39	3	0.8	2	0.5	1	0.3
Beverages	312	0.27	9.68	3	0.8	2	0.5	1	0.3
Misc. Foods and Kindred Products	289	0.20	9.45	3	0.8	2	0.5	1	0.3
Tobacco Manufacturers	24	0.19	8.85	3	0.8	2	0.5	1	0.3
Cigarettes	11	0.25	9.62	3	0.8	2	0.5	1	0.3
Textile Mill Products	684	0.44	5.8	2	0.3	3	0.3	2	0.2
Weaving Mills, Cotton	124	0.43	5.79	2	0.3	3	0.3	2	0.2
Weaving Mills, Synthetics	86	0.26	5.6	2	0.3	3	0.3	2	0.2
Weaving and Finishing Mills, Wool	62	0.53	5.9	2	0.3	3	0.3	2	0.2
Narrow Fabric Mills	11	0.17	5.49	1	0.2	1	0.2	1	0.3
Knitting Mills	100	0.23	5.52	2	0.3	3	0.3	2	0.3
Textile Finishing, Except Wool	127	0.93	6.37	2	0.3	3	0.3	2	0.3
Floor Covering Mills	50	0.43	5.79	2	0.3	3	0.3	2	0.3
Yarn and Thread Mills	65	0.26	5.59	2	0.3	3	0.3	2	0.2
Miscellaneous Textile Goods	59	0.16	5.48	1	0.2	1	0.2	1	0.3
Lumber and Wood Products	188	0.53	4.38	3	0.8	2	0.5	1	0.3
Sawmills and Planing Mills	81	0.85	5.52	3	0.8	2	0.5	1	0.3
Millwork, Plywood, Related Prod.	62	0.25	3.38	3	0.8	2	0.5	1	0.3
Miscellaneous Wood Products	38	0.38	3.84	3	0.8	2	0.5	1	0.3
Furniture and Fixtures	55	0.090	2.81	3	0.8	2	0.5	1	0.3
Household Furniture	28	0.039	2.63	3	0.8	2	0.5	1	0.3
Office Furniture	12	0.11	2.88	3	0.8	2	0.5	1	0.3
Misc. Furniture and Fixtures	6	0.18	3.13	3	0.8	2	0.5	1	0.3
Paper and Allied Products	619	6.54	25.72	10	3	10	3	8	2
Pulpmills	31	20.26	74.61	10	3	10	3	8	2
Papermills, Except Building Paper	249	8.54	32.89	10	3	10	3	8	2
Paperboard Mills	181	6.50	25.63	10	3	10	3	8	2
Misc. Converted Paper Products	76	0.50	4.27	10	3	10	3	8	2
Paperboard Containers and Boxes	41	0.13	2.95	10	3	10	3	8	2
Building Paper and Board Mills	41	1.83	9.00	10	3	10	3	8	2
Chemicals and Allied Products	1,125	1.79	23.73	7	0.7	7	0.7	0	0
Industrial Chemicals	582	2.51	30.18	7	0.7	7	0.7	0	0
Plastics Materials and Synthetics	193	1.48	20.95	4	0.35	6	3	4	0.4
Drugs	75	0.25	9.91	1	0.07	1	0.08	0	0
Soap, Cleaners, and Toilet Goods	65	0.14	8.93	1	0.07	1	0.08	0	0
[illegible]	[illegible]	[illegible]	[illegible]	1	0.07	1	0.08	0	0

Table 19. Wastewater treatment manpower requirements per estab
use estimated from both the EPA and ESSC models.

SIC Code	Industry Group and Industry	Establishments Reporting Consumption of Water	Mean Water Intake for Process Use MGD	EPA Models	Operation			
					Unskilled		Skilled	
					Total	FTE	Total	FT
20	Food and Kindred Products	2,345	0.34	9.91	3	0.8	2	0.
201	Meat Products	464	0.37	10.01	3	0.8	2	0.
202	Dairy Products	518	0.085	9.08	3	0.8	2	0.
203	Canned, Cured, and Frozen Foods	448	0.43	10.20	3	0.8	2	0.
204	Grain Mill Products	83	0.39	10.07	3	0.8	2	0.
205	Bakery Products	65	0.046	8.95	3	0.8	2	0.
206	Sugar	127	1.60	14.02	6	1.2	3	0.
207	Confectionery and Related Products	39	0.18	9.39	3	0.8	2	0.
208	Beverages	312	0.27	9.68	3	0.8	2	0.
209	Misc. Foods and Kindred Products	289	0.20	9.45	3	0.8	2	0.
21	Tobacco Manufacturers	24	0.19	8.85	3	0.8	2	0.
2111	Cigarettes	11	0.25	9.62	3	0.8	2	0.
22	Textile Mill Products	684	0.44	5.8	2	0.3	3	0.
2211	Weaving Mills, Cotton	124	0.43	5.79	2	0.3	3	0.
2221	Weaving Mills, Synthetics	86	0.26	5.6	2	0.3	3	0.
2231	Weaving and Finishing Mills, Wool	62	0.53	5.9	2	0.3	3	0.
2241	Narrow Fabric Mills	11	0.17	5.49	1	0.2	1	0.
225	Knitting Mills	100	0.23	5.52	2	0.3	3	0.
226	Textile Finishing, Except Wool	127	0.93	6.37	2	0.3	3	0.
227	Floor Covering Mills	50	0.43	5.79	2	0.3	3	0.
228	Yarn and Thread Mills	65	0.26	5.59	2	0.3	3	0.
229	Miscellaneous Textile Goods	59	0.16	5.48	1	0.2	1	0.
24	Lumber and Wood Products	188	0.53	4.38	3	0.8	2	0.
242	Sawmills and Planing Mills	81	0.85	5.52	3	0.8	2	0.
243	Millwork, Plywood, Related Prod.	62	0.25	3.38	3	0.8	2	0.
249	Miscellaneous Wood Products	38	0.38	3.84	3	0.8	2	0.
25	Furniture and Fixtures	55	0.090	2.81	3	0.8	2	0.
251	Household Furniture	28	0.039	2.63	3	0.8	2	0.
252	Office Furniture	12	0.11	2.88	3	0.8	2	0.
259	Misc. Furniture and Fixtures	6	0.18	3.13	3	0.8	2	0.
26	Paper and Allied Products	619	6.54	25.72	10	3	10	3
2611	Pulpmills	31	20.26	74.61	10	3	10	3
2621	Papermills, Except Building Paper	249	8.54	32.89	10	3	10	3
2631	Paperboard Mills	181	6.50	25.63	10	3	10	3
264	Misc. Converted Paper Products	76	0.50	4.27	10	3	10	3
265	Paperboard Containers and Boxes	41	0.13	2.95	10	3	10	3
2661	Building Paper and Board Mills	41	1.83	9.00	10	3	10	3
28	Chemicals and Allied Products	1,125	1.79	23.73	7	0.7	7	
281	Industrial Chemicals	582	2.51	30.18	7	0.7	7	
282	Plastics Materials and Synthetics	193	1.48	20.95	4	0.35	6	
283	Drugs	75	0.25	9.91	1	0.07	1	
284	Soap, Cleaners, and Toilet Goods	65	0.14	8.93	1	0.07	1	
2851	Paints and Allied Products	32	0.23	9.73	1	0.07	1	
2861	Gum and Wood Chemicals	14	0.16	9.11	1	0.07	1	
287	Agricultural Chemicals	60	1.32	19.51	4	0.35	6	
289	Miscellaneous Chemical Products	104	1.39	20.14	4	0.35	6	
	[illegible]	260	0.100	8.57	1	0.07	1	

ablishment by occupational category and SIC industry subdivisions based upon mean water intake rates

	Occupational Category																
	Laboratory								Maintenance				Instruments & Controls				
ed	Routine		Detailed Analyses		Special & Auto Analyses		Investi- gations		Unskilled		Skilled		Routine		Install- ation & Maint.		Fo
FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Tot
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.7	2	0.4	1	0.1	1	0.05	1	0.05	1	0.2	1	0.1	1	0.1	1	0.1	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	0.2	1
0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	0.3	3
0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	0.2	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0	1
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.3	3
0.7	0	0	4	1.05	3	0.35	0	0	3	0.56	2	0.25	3	1.05	4	0.45	0
0.7	0	0	4	1.05	3	0.35	0	0	3	0.56	2	0.25	3	1.05	4	0.45	0
3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0	0
0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	0	0.01	1	0.01	0
0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	0	0.01	1	0.01	0
0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.01	0
0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.01	0
3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0	0
3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0	0
[illegible]	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.01	0

divisions based upon mean water intake rates for process

cupational Category

Maintenance				Instruments & Controls				Supervision						Totals	
nskilled		Skilled		Routine		Installation & Maint.		Foreman		Professional		Management			
tal	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.2	1	0.1	1	0.1	1	0.1	1	0.2	1	0.3	1	0.1	21	3.6
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
1	0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
4	0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
1	0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
3	0.56	2	0.25	3	1.05	4	0.45	0	0	3	1.2	1	0.1	37	6.41
3	0.56	2	0.25	3	1.05	4	0.45	0	0	3	1.2	1	0.1	37	6.41
4	0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
1	0.03	1	0.03	0	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
1	0.03	1	0.03	0	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
1	0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
1	0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
4	0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
4	0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
[illegible]	[illegible]	[illegible]	[illegible]	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54

	Grain Mill Products								
205	Bakery Products	65	0.046	8.95	3	0.8	2	0.5	
206	Sugar	127	1.60	14.02	6	1.2	3	0.7	
207	Confectionery and Related Products	39	0.18	9.39	3	0.8	2	0.5	
208	Beverages	312	0.27	9.68	3	0.8	2	0.5	
209	Misc. Foods and Kindred Products	289	0.20	9.45	3	0.8	2	0.5	
21	Tobacco Manufacturers	24	0.19	8.85	3	0.8	2	0.5	
2111	Cigarettes	11	0.25	9.62	3	0.8	2	0.5	
22	Textile Mill Products	684	0.44	5.8	2	0.3	3	0.3	2
2211	Weaving Mills, Cotton	124	0.43	5.79	2	0.3	3	0.3	2
2221	Weaving Mills, Synthetics	86	0.26	5.6	2	0.3	3	0.3	2
2231	Weaving and Finishing Mills, Wool	62	0.53	5.9	2	0.3	3	0.3	2
2241	Narrow Fabric Mills	11	0.17	5.49	1	0.2	1	0.2	
225	Knitting Mills	100	0.23	5.52	2	0.3	3	0.3	2
226	Textile Finishing, Except Wool	127	0.93	6.37	2	0.3	3	0.3	2
227	Floor Covering Mills	50	0.43	5.79	2	0.3	3	0.3	2
228	Yarn and Thread Mills	65	0.26	5.59	2	0.3	3	0.3	2
229	Miscellaneous Textile Goods	59	0.16	5.48	1	0.2	1	0.2	1
24	Lumber and Wood Products	188	0.53	4.38	3	0.8	2	0.5	1
242	Sawmills and Planing Mills	81	0.85	5.52	3	0.8	2	0.5	1
243	Millwork, Plywood, Related Prod.	62	0.25	3.38	3	0.8	2	0.5	1
249	Miscellaneous Wood Products	38	0.38	3.84	3	0.8	2	0.5	1
25	Furniture and Fixtures	55	0.090	2.81	3	0.8	2	0.5	1
251	Household Furniture	28	0.039	2.63	3	0.8	2	0.5	1
252	Office Furniture	12	0.11	2.88	3	0.8	2	0.5	1
259	Misc. Furniture and Fixtures	6	0.18	3.13	3	0.8	2	0.5	1
26	Paper and Allied Products	619	6.54	25.72	10	3	10	3	8
2611	Pulpmills	31	20.26	74.61	10	3	10	3	8
2621	Papermills, Except Building Paper	249	8.54	32.89	10	3	10	3	8
2631	Paperboard Mills	181	6.50	25.63	10	3	10	3	8
264	Misc. Converted Paper Products	76	0.50	4.27	10	3	10	3	8
265	Paperboard Containers and Boxes	41	0.13	2.95	10	3	10	3	8
2661	Building Paper and Board Mills	41	1.83	9.00	10	3	10	3	8
28	Chemicals and Allied Products	1,125	1.79	23.73	7	0.7	7	0.7	0
281	Industrial Chemicals	582	2.51	30.18	7	0.7	7	0.7	0
282	Plastics Materials and Synthetics	193	1.48	20.95	4	0.35	6	3	4
283	Drugs	75	0.25	9.91	1	0.07	1	0.08	0
284	Soap, Cleaners, and Toilet Goods	65	0.14	8.93	1	0.07	1	0.08	0
2851	Paints and Allied Products	32	0.23	9.73	1	0.07	1	0.08	0
2861	Gum and Wood Chemicals	14	0.16	9.11	1	0.07	1	0.08	0
287	Agricultural Chemicals	60	1.32	19.51	4	0.35	6	3	4
289	Miscellaneous Chemical Products	104	1.39	20.14	4	0.35	6	3	4
29	Petroleum and Coal Products	260	0.100	8.57	1	0.07	1	0.08	0
2911	Petroleum Refining	214	1.17	18.16	1	0.07	1	0.08	0
295	Paving and Roofing Materials	37	0.21	9.55	1	0.07	1	0.08	0
299	Misc. Petroleum and Coal Products	9	0.061	8.21	1	0.07	1	0.08	0
30	Rubber and Plastics Products, Nec.	301	0.22	9.64	1	0.07	1	0.08	0
3011	Tires and Inner Tubes	53	0.44	11.62	1	0.07	1	0.08	0
3021	Rubber Footwear	7	0.078	8.37	1	0.07	1	0.08	0
3069	Fabricated Rubber Products, Nec.	108	0.17	9.19	1	0.07	1	0.08	0
3079	Miscellaneous Plastics Products	128	0.18	9.28	1	0.07	1	0.08	0
31	Leather and Leather Products	92	0.41	5.77	1	0.2	1	0.2	1
3111	Leather Tanning and Finishing	75	0.49	5.86	1	0.2	1	0.2	1
314	Footwear, Except Rubber	12	0.023	5.32	1	0.2	1	0.2	1

	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.2	3	0.7	2	0.4	1	0.1	1	0.05	1	0.05	1	0.2	1	0.1	1	0.1	1	
0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	
0.3	3	0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	0	
0.3	3	0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.3	3	0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.3	3	0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.2	1	0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	
0.3	3	0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.3	3	0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.3	3	0.3	2	0.3	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.3	3	0.3	2	0.2	1	0.2	1	0.2	2	0.1	4	0.2	4	0.3	1	0.1	1	
0.2	1	0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0.1	1	0.05	1	0.1	0	0
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
	10	3	8	2	0	0	0	0	6	0.6	0	0	6	3.3	0	0	3	0.
.7	7	0.7	0	0	4	1.05	3	0.35	0	0	3	0.56	2	0.25	3	1.05	4	0.
.7	7	0.7	0	0	4	1.05	3	0.35	0	0	3	0.56	2	0.25	3	1.05	4	0.
.35	6	3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	0	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	0	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.35	6	3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0
.35	6	3	4	0.4	1	0.03	0	0	1	0.02	4	0.42	4	0.3	2	0.2	0	0
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.07	1	0.08	0	0	1	0.06	0	0	0	0	1	0.03	1	0.03	1	0.01	1	0.
.2	1	0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	0.2
.2	1	0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	0.2
.2	1	0.2	1	0.3	1	0.1	1	0.1	1	0.1	1	0.1	2	0.3	1	0.1	1	0.2

0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.2	1	0.1	1	0.1	1	0.1	1	0.2	1	0.3	1	0.1	21	3.6
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.2	4	0.3	1	0.1	1	0.3	3	0.2	3	0.3	1	0.1	28	2.8
0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0.1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0	6	3.3	0	0	3	0.3	3	1.0	5	0.6	1	0.02	52	13.82
0.56	2	0.25	3	1.05	4	0.45	0	0	3	1.2	1	0.1	37	6.41
0.56	2	0.25	3	1.05	4	0.45	0	0	3	1.2	1	0.1	37	6.41
0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
0.03	1	0.03	0	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	0	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
0.42	4	0.3	2	0.2	0	0	0	0	3	0.7	1	0.1	30	5.52
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.03	1	0.03	1	0.01	1	0.01	0	0	1	0.2	1	0.05	8	0.54
0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1
0.1	2	0.3	1	0.1	1	0.2	1	0.1	1	0.2	1	0.1	14	2.1

Table 19. Continued.

SIC Code	Industry Group and Industry	Establishments Reporting Consumption of Water	Mean Water Intake for Process Use MGD	EPA Models	Operation			
					Unskilled		Skilled	
					Total	FTE	Total	FTE
32	Stone, Clay, and Glass Products	586	0.42	10.17	3	0.8	2	0.5
3211	Flat Glass	20	1.15	12.55	6	1.2	3	0.7
322	Glass, Glassware, Pressed or Blown	103	0.13	9.22	3	0.8	2	0.5
3231	Products of Purchased Glass	21	0.26	9.65	3	0.8	2	0.5
3241	Cement, Hydraulic	142	0.41	10.14	3	0.8	2	0.5
325	Structural Clay Products	13	0.063	9.0	3	0.8	2	0.5
326	Pottery and Related Products	23	0.060	9.0	3	0.8	2	0.5
327	Concrete, Gypsum, Plaster Products	114	0.31	9.81	3	0.8	2	0.5
3281	Cut Stone and Stone Products	17	0.61	5.8	3	0.8	2	0.5
329	Misc. Nonmetallic Mineral Products	133	0.72	6.04	3	0.8	2	0.5
33	Primary Metal Industries	841	3.93	24.52	1	0.2	1	0.4
331	Blast Furnace, Basic Steel Prod.	308	9.33	42.18	3	0.4	3	0.6
332	Iron and Steel Foundries	136	0.24	12.45	1	0.2	1	0.4
333	Primary Nonferrous Metals	78	3.12	21.87	1	0.2	1	0.4
3341	Secondary Nonferrous Metals	20	0.14	12.13	1	0.2	1	0.4
335	Nonferrous Rolling and Drawing	170	0.74	14.09	1	0.2	1	0.4
336	Nonferrous Foundries	52	0.32	12.72	1	0.2	1	0.4
339	Misc. Primary Metal Products	77	0.15	12.16	1	0.2	1	0.4
34	Fabricated Metal Products	569	0.18	4.38	2	0.2	2	0.2
3411	Metal Cans	28	0.029	3.71	1	0.1	1	0.1
342	Cultery, Handtools, and Hardware	76	0.30	4.92	2	0.2	2	0.2
343	Plumbing and Heating Exc. Electrical	38	0.23	4.61	2	0.2	2	0.2
344	Fabricated Structural Metal Prod.	61	0.090	3.98	1	0.1	1	0.1
345	Screw Machine Products, Bolts, Etc.	49	0.22	4.56	2	0.2	2	0.2
3461	Metal Stampings	87	0.25	4.7	2	0.2	2	0.2
347	Metal Services, Nec.	118	0.17	4.34	2	0.2	2	0.2
3481	Misc. Fabricated Wire Products	20	0.11	4.07	2	0.2	2	0.2
349	Misc. Fabricated Metal Products	92	0.11	4.07	2	0.2	2	0.2
35	Machinery, Except Electrical	471	0.17	4.34	2	0.2	2	0.2
351	Engines and Turbines	37	0.35	5.14	2	0.2	2	0.2
3522	Farm Machinery	37	0.39	5.32	2	0.2	2	0.2
353	Construction and Related Machinery	74	0.25	4.7	2	0.2	2	0.2
354	Metalworking Machinery	69	0.068	3.88	1	0.1	1	0.1
355	Special Industry Machinery	39	0.11	4.07	2	0.2	2	0.2
356	General Industrial Machinery	96	0.074	3.91	1	0.1	1	0.1
357	Office and Computing Machines	43	0.13	4.16	2	0.2	2	0.2
358	Service Industry Machines	50	0.15	4.25	2	0.2	2	0.2
3599	Misc. Machinery, Except Electrical	26	0.18	4.38	2	0.2	2	0.2
36	Electrical Equip. and Supplies	562	0.23	4.61	2	0.2	2	0.2
361	Electric Test, Distributing Equip.	53	0.13	4.16	2	0.2	2	0.2
362	Electrical Industrial Apparatus	76	0.17	4.34	2	0.2	2	0.2
363	Household Appliances	67	0.67	6.57	2	0.2	2	0.2
364	Elect. Lighting, and Wiring Equip.	73	0.15	4.25	2	0.2	2	0.2
365	Radio and TV Receiving Equipment	34	0.14	4.2	2	0.2	2	0.2
366	Communication Equipment	88	0.14	4.2	2	0.2	2	0.2

EPA Models													Occupa	
	Operation				Laboratory								Ma	
	Unskilled		Skilled		Routine		Detailed Analyses		Special & Auto Analyses		Investigations		Unskill	
	Total	FTE	Total	FTE	Tota'	FTE	Total	FTE	Total	FTE	Total	FTE	Total	F
10.17	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
12.55	6	1.2	3	0.7	2	0.4	1	0.1	1	0.05	1	0.05	1	0
9.22	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
9.65	3	0.8	2	0.5	1	0.3	1	0.1	0	0	1	0	1	0
10.14	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
9.0	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
9.0	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
9.81	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
5.8	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
6.04	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
24.52	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0
42.18	3	0.4	3	0.6	3	0.2	1	0.3	1	0.2	0	0	1	0.
12.45	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
21.87	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
12.13	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
14.09	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
12.72	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
12.16	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
4.38	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
3.71	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
4.92	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.61	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
3.98	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
4.56	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.7	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
5.14	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
5.32	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.7	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
3.88	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
3.91	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.25	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.38	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.61	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
6.57	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.25	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.2	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
4.2	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
[illegible]	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.

ional Category

intenance							Supervision						Totals	
ed	Skilled		Routine		Installation & Maint.		Foreman		Professional		Management			
TE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
2	1	0.1	1	0.1	1	0.1	1	0.2	1	0.3	1	0.1	21	3.6
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
1	1	0.05	1	0.1	0	0	1	0.1	1	0.05	1	0.05	13	2.15
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
8	2	0.3	4	0.4	1	0.4	3	0.2	1	0.5	1	0.1	30	4.4
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7

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tine	Instal ation Main
FTE	Total
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33	Primary Metal Industries	841	3.93	24.52	1	0.2	1	0.4
331	Blast Furnace, Basic Steel Prod.	308	9.33	42.18	3	0.4	3	0.6
332	Iron and Steel Foundries	136	0.24	12.45	1	0.2	1	0.4
333	Primary Nonferrous Metals	78	3.12	21.87	1	0.2	1	0.4
3341	Secondary Nonferrous Metals	20	0.14	12.13	1	0.2	1	0.4
335	Nonferrous Rolling and Drawing	170	0.74	14.09	1	0.2	1	0.4
336	Nonferrous Foundries	52	0.32	12.72	1	0.2	1	0.4
339	Misc. Primary Metal Products	77	0.15	12.16	1	0.2	1	0.4
34	Fabricated Metal Products	569	0.18	4.38	2	0.2	2	0.2
3411	Metal Cans	28	0.029	3.71	1	0.1	1	0.1
342	Cultery, Handtools, and Hardware	76	0.30	4.92	2	0.2	2	0.2
343	Plumbing and Heating Exc. Electrical	38	0.23	4.61	2	0.2	2	0.2
344	Fabricated Structural Metal Prod.	61	0.090	3.98	1	0.1	1	0.1
345	Screw Machine Products, Bolts, Etc.	49	0.22	4.56	2	0.2	2	0.2
3461	Metal Stampings	87	0.25	4.7	2	0.2	2	0.2
347	Metal Services, Nec.	118	0.17	4.34	2	0.2	2	0.2
3481	Misc. Fabricated Wire Products	20	0.11	4.07	2	0.2	2	0.2
349	Misc. Fabricated Metal Products	92	0.11	4.07	2	0.2	2	0.2
35	Machinery, Except Electrical	471	0.17	4.34	2	0.2	2	0.2
351	Engines and Turbines	37	0.35	5.14	2	0.2	2	0.2
3522	Farm Machinery	37	0.39	5.32	2	0.2	2	0.2
353	Construction and Related Machinery	74	0.25	4.7	2	0.2	2	0.2
354	Metalworking Machinery	69	0.068	3.88	1	0.1	1	0.1
355	Special Industry Machinery	39	0.11	4.07	2	0.2	2	0.2
356	General Industrial Machinery	96	0.074	3.91	1	0.1	1	0.1
357	Office and Computing Machines	43	0.13	4.16	2	0.2	2	0.2
358	Service Industry Machines	50	0.15	4.25	2	0.2	2	0.2
3599	Misc. Machinery, Except Electrical	26	0.18	4.38	2	0.2	2	0.2
36	Electrical Equip. and Supplies	562	0.23	4.61	2	0.2	2	0.2
361	Electric Test, Distributing Equip.	53	0.13	4.16	2	0.2	2	0.2
362	Electrical Industrial Apparatus	76	0.17	4.34	2	0.2	2	0.2
363	Household Appliances	67	0.67	6.57	2	0.2	2	0.2
364	Elect. Lighting, and Wiring Equip.	73	0.15	4.25	2	0.2	2	0.2
365	Radio and TV Receiving Equipment	34	0.14	4.2	2	0.2	2	0.2
366	Communication Equipment	88	0.14	4.2	2	0.2	2	0.2
3671	Electron Tubes, Receiving Type	9	0.091	3.99	1	0.1	1	0.1
369	Misc. Electrical Equip., Supplies	63	0.21	4.52	2	0.2	2	0.2
37	Transportation Equipment	392	0.44	5.54	0	0	1	0.25
371	Motor Vehicles and Equipment	217	0.54	5.99	1	1	1	0.25
372	Aircraft and Parts	114	0.41	5.41	0	0	1	0.25
373	Ship and Boat Building, Repairing	32	0.15	4.25	0	0	1	0.8
374	Railroad Equipment	20	0.14	4.2	0	0	1	0.8
38	Instruments and Related Products	107	0.43	5.5	0	0	1	0.25
3811	Engineering, Scientific Instruments	8	0.068	3.88	0	0	1	0.5
382	Mechan. Measuring, Control Devices	32	0.20	4.47	0	0	1	0.8
3831	Optical Instruments and Lenses	6	0.046	3.79	0	0	1	0.5
384	Medical Instruments and Supplies	20	0.14	4.2	0	0	1	0.8
3851	Ophthalmic Goods	7	0.31	4.96	0	0	1	0.25
3861	Photographic Equipment and Supplies	26	1.10	8.49	1	1	5	3
387	Watches, Clocks, and Watchcases	8	0.62	6.35	1	0.8	2	1.5
39	Misc. Manufacturing Industries	97	0.13	4.16	2	0.2	2	0.2
391	Jewelry, Silverware, Plated Ware	15	0.13	4.16	2	0.2	2	0.2
394	Toys and Sporting Goods	24	0.13	4.16	2	0.2	2	0.2
395	Pens, Pencils, Office, Art Goods	11	0.025	3.69	1	0.1	1	0.1
396	Costume Jewelry and Notions	19	0.17	4.34	2	0.2	2	0.2
399	Miscellaneous Manufactures	22	0.20	4.47	2	0.2	2	0.2

	6.04	3	0.8	2	0.5	1	0.3	1	0.1	0	0	0	0	1	0
03	24.52	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0
33	42.18	3	0.4	3	0.6	3	0.2	1	0.3	1	0.2	0	0	7	0
34	12.45	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0
12	21.87	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0
14	12.13	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
74	14.09	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
02	12.72	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
15	12.16	1	0.2	1	0.4	1	0.2	1	0.05	1	0.05	1	0.1	1	0.
18	4.38	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
029	3.71	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
30	4.92	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
23	4.61	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
090	3.98	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
22	4.56	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
25	4.7	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
17	4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
11	4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
11	4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
17	4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
35	5.14	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
09	5.32	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
25	4.7	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
068	3.88	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
11	4.07	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
074	3.91	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
13	4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
15	4.25	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
18	4.38	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
23	4.61	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
13	4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
17	4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
67	6.57	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
15	4.25	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
14	4.2	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
14	4.2	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
091	3.99	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0.
21	4.52	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
44	5.54	0	0	1	0.25	0	0	1	0.25	0	0	0	0	0	0
54	5.99	1	1	1	0.25	1	0.1	1	0.1	1	0.05	1	0.05	1	0.
41	5.41	0	0	1	0.25	0	0	1	0.25	0	0	0	0	0	0
15	4.25	0	0	1	0.8	1	0.2	1	0.1	8	0.08	8	0.07	0	0
14	4.2	0	0	1	0.8	1	0.2	1	0.1	8	0.08	8	0.07	0	0
43	5.5	0	0	1	0.25	0	0	1	0.25	0	0	0	0	0	0
068	3.88	0	0	1	0.5	0	0	1	0.1	1	0.05	1	0.05	0	0
20	4.47	0	0	1	0.8	1	0.2	1	0.1	8	0.08	8	0.07	0	0
046	3.79	0	0	1	0.5	0	0	1	0.1	1	0.05	1	0.05	0	0
14	4.2	0	0	1	0.8	1	0.2	1	0.1	8	0.08	8	0.07	0	0
31	4.96	0	0	1	0.25	0	0	1	0.25	0	0	0	0	0	0
10	8.49	1	1	5	3	5	1	1	0.15	1	0.15	1	0.15	5	0.
62	6.35	1	0.8	2	1.5	1	0.4	1	0.1	1	0.05	1	0.05	1	0.
13	4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
13	4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.
13	4.16	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0
025	3.69	1	0.1	1	0.1	1	0.1	1	0.2	0	0	0	0	1	0
17	4.34	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0
20	4.47	2	0.2	2	0.2	2	0.2	1	0.2	0	0	0	0	1	0.

	2	0.3	4	0.4	1	0.4	3	0.2	1	0.5	1	0.1	[illegible]	[illegible]			
	[illegible]	[illegible]	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8	1	0	0
	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8		0	0
	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8		1	0.
	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8		1	0.
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8		1	0.
2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	13	1.8		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7	.1	0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7	.1	0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		3	0.
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		3	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		4	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		4	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		1	0.
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7		0	0
	1	0.2	0	0	1	0.05	0	0	1	0.05	0	0	5	0.8		0	0
1	0	0	1	0.1	1	0.05	1	0.05	1	0.05	1	0.1	12	2		1	0.
	1	0.2	0	0	1	0.05	0	0	1	0.05	0	0	23	1.77		1	0.
	1	0.2	1	0.15	0	0	0	0	1	0.25	1	0.1	23	1.77		1	0.
	1	0.2	1	0.15	0	0	0	0	1	0.25	1	0.1	23	1.77		1	0.
	1	0.2	0	0	1	0.05	0	0	1	0.05	0	0	14	1.7		1	0.
	1	0.1	0	0	1	0.1	0	0	1	0.2	1	0.05	8	1.15		1	0.
	1	0.2	1	0.15	0	0	0	0	1	0.25	1	0.1	23	1.77		1	0.
	1	0.1	0	0	1	0.1	0	0	1	0.2	1	0.05	8	1.15		1	0.
	1	0.2	1	0.15	0	0	0	0	1	0.25	1	0.1	23	1.77		1	0.
	1	0.2	0	0	1	0.05	0	0	1	0.05	0	0	14	1.7		1	0.
5	0	0	1	0.25	1	0.1	1	0.6	1	0.8	1	0.3	24	8		1	0.
2	2	0.2	2	0.3	0	0	1	0.1	0	0	1	0.05	14	3.75		1	0.
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7			
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7			
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7			
1	1	0.2	1	0.05	1	0.1	1	0.1	1	0.1	1	0.05	11	1.2			
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7			
2	1	0.2	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	14	1.7			

CHAPTER IV

PROJECTED EMPLOYMENT AND MANPOWER NEEDS IN WATER POLLUTION CONTROL

EPA Mean Employment

The estimated employment by occupational categories and industry groups shown in Tables 20-25 for the years 1971 through 1976 are based upon the mean number of people employed per industry determined from the EPA survey which were summarized in Tables 5-10. These mean values were multiplied by the total number of establishments in each industry group to obtain the number of employees shown in Tables 20-25. It was assumed that the total number of establishments in each group had not changed since 1968. This assumption may introduce a small error but it is doubted that this will have any influence on the overall estimates because of the wide variability in the raw data.

There appears to be very little difference between the estimates of manpower employed in 1971 and the needs projected for 1976. This is probably attributable to the reporting pattern in the EPA survey mentioned earlier. Because it was assumed that the total number of industries in each industry category had not changed since 1968, there would not be any significant differences in projected and present

Table 20. Projected manpower employed according to occupational category for major water users by industry group based on the average number of employees obtained
industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Number of Employees in 1971: Occupational Categories: Superintendent	Engineer/Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator/Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other
20	**Food & Kindred Products**	32,518	1,650	15,900	21,800	11,100	5,530	17,900	17,600	26,700	5,500	39,000	11,700	23,700	7,200	8,130
22	**Textile Mill Products**	7,080	929	920	920	920	0	2,690	0	920	1,770	7,080	0	920	0	8,850
24	**Lumber & Wood Products**	36,795	554	0	0	0	0	0	0	0	0	0	0	0	0	18,400
26	**Paper & Allied Products**	5,890	639	5,890	5,130	2,000	236	7,190	6,420	9,480	3,360	8,950	4,120	1,770	2,060	0
28	**Chemicals & Allied Products**	11,799	841	11,200	16,400	10,700	1,180	16,000	13,700	21,700	7,080	27,700	8,020	9,560	5,310	2,360
29	**Petroleum & Coal Products**	1,880	142	2,090	4,880	1,670	0	3,550	2,090	4,170	830	7,110	2,930	5,640	1,470	620
30	**Rubber & Plastics Products**	6,456	517	3,620	1,420	710	710	710	1,420	0	0	5,040	710	1,420	0	0
32	**Stone, Clay, & Glass Products**	15,580	590	15,580	7,790	0	0	7,790	0	15,540	15,580	7,790	0	0	0	23,370
33	**Primary Metals Industries**	6,837	1,281	4,310	5,540	4,920	342	6,220	6,220	6,020	2,870	12,100	2,390	4,5	1,910	137
34	**Fabricated Metal Products**	27,418	1,342	13,700	13,700	13,700		20,600	13,700	13,700		41,100	27,400	13,700		
35	**Machinery, Except Electrical**	37,892	1,864											37,900		
36	**Electrical Equip. & Supplies**	10,706	1,875	5,350	10,700	5,350		10,700				10,700	10,700			
37	**Transportation Equipment**	7,483	1,834	5,010	3,740			1,270	5,010	23,700		13,700	3,740	2,470		
38	**Instruments & Related Products**	4,453	394	4,450						4,450		4,450				
Total	**United States**	241,298[b]	16,104[b]													

[a] Bureau of the Census, 1971.

[b] SIC 21, 25, 31, 39 are included.

ployed according to occupational category for major water users by industry group based on the average number of employees obtained in EPA

Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Number of Employees in 1971													Total of all Occupational Categories
		Occupational Categories													
		Superintendent	Engineer/ Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator/ Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other	
32,518	1,650	15,900	21,800	11,100	5,530	17,900	17,600	26,700	5,500	39,000	11,700	23,700	7,200	8,130	211,760
7,080	929	920	920	920	0	2,690	0	920	1,770	7,080	0	920	0	8,930	24,990
36,795	554	0	0	0	0	0	0	0	0	0	0	0	0	18,400	18,400
5,890	639	5,890	5,130	2,000	230	7,190	6,420	9,480	3,360	8,950	4,120	1,770	2,060	0	56,600
11,799	841	11,200	16,400	10,700	1,180	16,000	13,700	21,700	7,080	27,700	8,020	9,560	8,310	2,360	153,910
1,880	142	2,090	1,880	1,670	0	3,550	2,090	4,170	830	7,110	2,930	5,660	1,470	620	34,070
6,456	517	3,620	1,420	710	710	710	1,420	0	0	5,040	710	1,420	0	0	15,760
15,580	590	15,580	7,790	0	0	7,790	0	15,580	15,580	7,790	0	0	0	23,170	93,480
6,837	1,281	4,310	5,540	4,920	342	6,220	6,220	6,020	2,870	12,100	2,390	4,580	1,910	137	57,559
27,418	1,342	13,700	13,700	13,700		20,600	13,700	13,700		41,100	27,400	13,700			171,300
37,892	1,864											37,900			37,900
10,706	1,875	5,350	10,700	5,350		10,700				10,700	10,700				53,500
7,483	1,834	5,010	3,740			1,270	5,010	23,700		13,700	3,740	2,470			58,640
4,453	394	4,450						4,450		4,450					13,350
241,298[b]	16,104[b]														999,205

d.

Table 21. Projected manpower employed according to occupational category for major water users
industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist
20	Food & Kindred Products	32,518	1,650	15,900	19,500	10,400	7,150
22	Textile Mill Products	7,080	929	1,200	0	1,200	0
24	Lumber & Wood Products	36,795	554	0	18,400	0	0
26	Paper & Allied Products	5,890	639	4,650	5,480	2,530	0
28	Chemicals & Allied Products	11,799	841	11,400	16,800	10,000	944
29	Petroleum & Coal Products	1,880	142	2,140	1,620	1,620	0
30	Rubber & Plastics Products	6,456	517	2,780	1,870	904	0
32	Stone, Clay, & Glass Products	15,580	590	15,600	7,790	0	0
33	Primary Metals Industries	6,837	1,281	4,310	5,880	4,720	410
34	Fabricated Metal Products	27,418	1,342	27,400	0	0	0
35	Machinery, Except Electrical	37,892	1,864	0	0	0	0
36	Electrical Equip. & Supplies	10,706	1,875	5,350	10,700	5,350	0
37	Transportation Equipment	7,483	1,834	5,990	4,490	0	0
38	Instruments & Related Products	4,453	394	4,450	0	0	0
Total	United States	241,298[b]	16,104[b]				

[a] Bureau of the Census, 1971.

[b] SIC 21, 25, 31, 39 are included.

nal category for major water users by industry group based on the averag

nts	Number of Employees in 1972									
	Occupational Categories									
	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	
	15,900	19,500	10,400	7,150	17,600	20,500	25,000	5,200	39,300	19,
	1,200	0	1,200	0	3,540	0	1,200	1,200	1,200	
	0	18,400	0	0	0	18,400	0	0	0	
	4,650	5,480	2,530	0	7,130	3,770	10,500	3,360	13,000	3,
	11,400	16,800	10,000	944	17,000	14,000	20,600	[illegible],320	28,800	7,
	2,140	1,620	1,620	0	2,950	2,690	5,380	1,070	8,070	
	2,780	1,870	904	0	904	1,870	0	0	4,580	
	15,600	7,790	0	0	7,790	0	15,580	15,580	7,790	
	4,310	5,880	4,720	410	6,220	6,630	7,450	3,490	13,700	2,
	27,400	0	0	0	0	0	27,400	0	27,400	
	0	0	0	0	0	0	0	0	0	
	5,350	10,700	5,350	0	16,100	0	0	0	10,700	10,
	5,990	4,490	0	0	1,500	4,490	22,400	0	13,500	4,
	4,450	0	0	0	0	0	4,450	0	4,450	

number of employees obtained in EPA

	Unskilled	Clerical	Other	Total of all Occupational Categories
00	17, 600	6, 180	8, 450	211, 980
0	1, 200	0	5, 880	16, 620
0	0	0	18, 400	55, 200
70	1, 710	1, 240	0	57, 140
00	10, 100	5, 310	2, 600	152, 074
0	7, 260	1, 330	263	34, 393
0	1, 870	0	0	14, 788
0	0	0	23, 400	93, 530
40	5, 670	1, 980	0	63, 400
0	0	0	0	82, 200
0	37, 900	0	0	37, 900
00	0	0	0	58, 900
90	2, 990	0	0	59, 850
0	0	0	0	13, 350
				951, 325

Table 22. Projected manpower employed according to occupational category for major water users by industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician
20	Food & Kindred Products	32,518	1,650	17,200	20,500	12,400	6,500	15,
22	Textile Mill Products	7,080	929	2,340	2,340	1,200	0	3,5
24	Lumber & Wood Products	36,795	554	0	18,400	0	0	
26	Paper & Allied Products	5,890	639	5,010	5,010	2,240	0	5,
28	Chemicals & Allied Products	11,799	841	11,900	17,800	10,400	1,060	17,
29	Petroleum & Coal Products	1,860	142	2,260	1,500	1,500	0	3,3
30	Rubber & Plastics Products	6,456	517	3,230	2,130	1,100	0	1,1
32	Stone, Clay, & Glass Products	15,580	590	15,580	15,580	0	0	
33	Primary Metals Industries	6,837	1,281	4,380	6,430	4,990	410	7,0
34	Fabricated Metal Products	27,418	1,342	27,418	0	0	0	
35	Machinery, Except Electrical	37,892	1,864	0	0	0	0	
36	Electrical Equip. & Supplies	10,706	1,875	10,700	10,700	10,700	0	
38	Instruments & Related Products	4,453	394	4,453	0	0	0	
Total	United States	241,298[b]	16,104[b]					

[a] Bureau of the Census, 1971.

[b] SIC 21, 25, 31, 37, 39 are included.

water users by industry group based on the average number of employees obtained in EPA

Number of Employees in 1973											
Occupational Categories											Total of all Occupational Categories
	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other	
400	6,500	15,900	22,100	25,000	5,530	39,000	22,800	19,500	5,200	7,800	219,430
200	0	3,540	0	1,200	1,200	9,420	0	1,200	0	5,880	28,320
0	0	0	18,400	0	0	0	0	0	0	18,400	55,200
240	0	5,890	2,710	6,770	2,710	12,200	4,060	1,830	880	0	49,310
400	1,060	17,900	15,300	24,300	8,610	31,100	7,910	11,000	5,660	2,830	165,770
500	0	3,380	3,380	7,140	1,500	10,900	0	10,200	1,500	376	43,636
100	0	1,100	2,130	0	0	5,360	0	2,130	0	0	17,180
0	0	0	0	31,200	0	15,580	0	0	0	0	77,940
990	410	7,040	7,250	8,070	3,760	14,900	3,080	6,220	2,050	0	68,580
0	0	0	0	27,418	0	27,418	0	0	0	0	82,254
0	0	0	0	0	0	0	0	37,900	0	0	37,900
700	0	0	0	0	0	10,700	10,700	0	0	0	53,500
0	0	0	0	4,453	0	4,453	0	0	0	0	13,359
											912,379

Table 23. Projected manpower employed according to occupational category for major water users by ind
industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Numb				
				Oc				
				Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician
20	Food & Kindred Products	32,518	1,650	16,600	19,800	10,700	6,830	16,300
22	Textile Mill Products	7,080	929	2,340	1,200	1,200	0	3,540
24	Lumber & Wood Products	36,795	554	0	18,400	0	0	0
26	Paper & Allied Products	5,890	639	4,300	4,830	2,650	0	4,300
28	Chemicals & Allied Products	11,799	841	11,800	17,600	10,600	944	18,200
29	Petroleum & Coal Products	1,880	142	2,260	1,500	1,500	0	3,380
30	Rubber & Plastics Products	6,456	517	3,230	2,130	1,100	0	1,100
32	Stone, Clay, & Glass Products	15,580	590	15,580	15,580	0	0	0
33	Primary Metals Industries	6,837	1,281	4,300	6,150	5,260	479	7,320
34	Fabricated Metal Products	27,418	1,342	27,418	0	0	0	0
35	Machinery, Except Electrical	37,892	1,864	0	0	0	0	0
36	Electrical Equip. & Supplies	10,706	1,875	10,700	10,700	10,700	0	0
38	Instruments & Related Products	4,453	394	4,450	0	0	0	0
Total	United States	241,298[b]	16,104[b]					

[a] Bureau of the Census, 1971.

[b] SIC 21, 25, 31, 37, 39 are included.

ding to occupational category for major water users by industry group based on the averag

Total[a] Number of Employees of all Establishments (1,000)	Number of Employees in 1974									
	Occupational Categories									
	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant
1,650	16,600	19,800	10,700	6,830	16,300	21,800	26,000	5,530	37,400	21,
929	2,340	1,200	1,200	0	3,540	0	1,200	1,200	9,420	
554	0	18,400	0	0	0	18,400	0	0	0	
639	4,300	4,830	2,650	0	4,300	3,240	10,200	3,240	13,400	4,
841	11,800	17,600	10,600	944	18,200	15,800	25,800	8,850	31,000	8,
142	2,260	1,500	1,500	0	3,380	3,380	6,770	1,500	10,900	
517	3,230	2,130	1,100	0	1,100	2,130	0	0	5,360	
590	15,580	15,580	0	0	0	0	31,200	0	15,580	
1,281	4,300	6,150	5,260	479	7,320	7,520	9,090	3,420	15,500	2,
1,342	27,418	0	0	0	0	0	27,418	0	27,418	
1,864	0	0	0	0	0	0	0	0	0	
1,875	10,700	10,700	10,700	0	0	0	0	0	10,700	10,
394	4,450	0	0	0	0	0	4,450	0	4,450	
16,104[b]										

cted manpower eme number of employees obtained in EPA
trial survey.

ustry Group		Unskilled	Clerical	Other	Total of all Occupational Categories
dred Products	800	19,500	5,200	7,150	214,610
l Products	0	1,200	0	5,880	27,180
Wood Products	0	0	0	18,400	55,200
llied Products	830	2,120	1,060	0	54,170
& Allied Products	380	10,900	5,660	2,950	168,484
& Coal Products	0	9,780	1,130	376	42,476
Plastics Products	0	2,130	0	0	17,180
, & Glass Produc	0	0	0	0	77,940
etals Industries	730	5,670	2,260	0	69,694
Metal Products	0	0	0	0	82,254
, Except Electrica	0	37,892	0	0	37,892
Equip. & Supplies	700	0	0	0	53,500
& Related Produ	0	0	0	0	13,350
es					913,935

the Census, 1971

5, 31, 37, 39 are :

Table 24. Projected manpower employed according to occupational category for major water u industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist
20	Food & Kindred Products	32,518	1,650	16,600	20,500	10,100	7,4
22	Textile Mill Products	7,080	929	2,340	1,200	1,200	
24	Lumber & Wood Products	36,795	554	0	18,400	0	
26	Paper & Allied Products	5,890	639	4,120	4,710	2,360	
28	Chemicals & Allied Products	11,799	841	12,500	17,900	11,100	1,0
29	Petroleum & Coal Products	1,880	142	2,260	1,500	1,500	
30	Rubber & Plastics Products	6,456	517	3,230	2,130	1,100	
32	Stone, Clay, & Glass Products	15,580	590	15,580	15,580	0	
33	Primary Metals Industries	6,837	1,281	4,380	5,130	4,850	4
34	Fabricated Metal Products	27,418	1,342	27,418	0	0	
35	Machinery, Except Electrical	37,892	1,864	0	0	0	
36	Electrical Equip. & Supplies	10,706	1,875	10,700	10,700	10,700	
38	Instruments & Related Products	4,453	394	4,450	0	0	
Total	United States	241,298[b]	16,104[b]				

[a] Bureau of Census, 1971.

[b] SIC 21, 25, 31, 37, 39 are included.

rs by industry group based on the average number of employees obtained in EPA

Number of Employees in 1975									
Occupational Categories									
Laboratory Technician	Senior Operator/ Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant	Unskilled	Clerical	Other	Total of all Occupational Categories
15,900	22,100	27,300	5,850	37,700	22,800	20,800	5,850	6,830	219,810
3,540	0	1,200	1,200	9,420	0	1,200	0	5,880	27,180
0	18,400	0	0	0	0	0	0	18,400	55,200
4,120	3,530	10,600	2,950	14,100	5,300	2,360	589	0	54,739
18,500	16,200	26,400	9,090	31,500	8,610	10,900	5,660	2,950	172,370
3,380	3,380	6,770	1,500	10,900	0	9,780	1,130	376	42,476
1,100	2,130	0	0	5,360	0	2,130	0	0	17,180
0	0	31,200	0	15,580	0	0	0	0	77,940
7,790	7,790	9,300	3,420	15,100	2,190	3,900	2,190	0	66,519
0	0	27,418	0	27,418	0	0	0	0	82,254
0	0	0	0	0	0	37,892	0	0	37,892
0	0	0	0	10,700	10,700	0	0	0	53,500
0	0	4,450	0	4,450	0	0	0	0	13,350
									920,410

Table 25. Projected manpower employed according to occupational category for major water users industrial survey.

SIC Code	Industry Group	Total[a] Number of Industries in Group	Total[a] Number of Employees of all Establishments (1,000)	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laborator
20	Food & Kindred Products	32,518	1,650	17,200	20,200	10,400	7,480	15
22	Textile Mill Products	7,080	929	2,340	1,200	1,200	0	3
24	Lumber & Wood Products	36,795	554	0	18,400	0	0	
26	Paper & Allied Products	5,890	639	4,120	4,710	2,360	0	4
28	Chemicals & Allied Products	11,799	841	11,900	17,900	11,300	1,060	18
29	Petroleum & Coal Products	1,880	142	2,260	1,500	1,500	0	3
30	Rubber & Plastics Products	6,456	517	3,230	2,130	1,100	0	1
32	Stone, Clay, & Glass Products	15,580	590	15,580	15,580	0	0	
33	Primary Metals Industries	6,837	1,281	4,240	4,990	4,720	547	7
34	Fabricated Metal Products	27,418	1,342	27,400	0	0	0	
35	Machinery, Except Electrical	37,892	1,864	0	0	0	0	
36	Electrical Equip. & Supplies	10,706	1,875	10,700	10,700	10,700	0	
38	Instruments & Related Products	4,453	394	4,450	0	0	0	
Total	United States	241,298[b]	16,104[b]					

[a] Bureau of Census, 1971.

[b] SIC 21, 25, 31, 37, 39 are included.

occupational category for major water users by industry group based on the averag

Total[a] Number of mployees of all blishments (1,000)	Number of Employees in 1976									
	Occupational Categories									
	Superintendent	Engineer / Sanitary Engineer	Chemist	Biologist	Laboratory Technician	Senior Operator / Foreman	Equipment Operator	Instrument Repairman	Maintenance Man	Attendant
1,650	17,200	20,200	10,400	7,480	15,900	22,100	27,600	5,530	37,400	22,
929	2,340	1,200	1,200	0	3,540	0	1,200	1,200	9,420	
554	0	18,400	0	0	0	18,400	0	0	0	
639	4,120	4,710	2,360	0	4,120	3,500	10,600	2,950	14,100	5,
841	11,900	17,900	11,300	1,060	18,800	16,000	26,700	9,090	31,600	8,
142	2,260	1,500	1,500	0	3,380	3,380	6,390	1,500	10,900	
517	3,230	2,130	1,100	0	1,100	2,130	0	0	5,360	
590	15,580	15,580	0	0	0	0	31,200	0	15,580	
1,281	4,240	4,990	4,720	547	7,380	7,860	9,980	3,690	14,700	2,
1,342	27,400	0	0	0	0	0	27,400	0	27,400	
1,864	0	0	0	0	0	0	0	0	0	
1,875	10,700	10,700	10,700	0	0	0	0	0	10,700	10,
394	4,450	0	0	0	0	0	4,450	0	4,450	
16,104[b]										

number of employees obtained in EPA

	Unskilled	Clerical	Other	Total of all Occupational Categories
00	20,500	5,530	6,830	219,470
0	1,200	0	5,880	27,180
0	0	0	18,400	55,200
00	2,360	589	0	54,709
00	10,900	5,660	2,830	172,240
0	9,780	1,130	376	42,096
0	2,130	0	0	17,180
0	0	0	0	77,940
00	3,970	2,390	0	67,067
0	0	0	0	82,200
0	37,900	0	0	37,900
700	0	0	0	53,500
0	0	0	0	13,350
				920,032

manpower needs. This should not be interpreted to mean that there will not be a significant increase in manpower devoted to wastewater treatment in all industrial categories. Projections made from these studies are probably reasonable estimates of the needs within the next three to five years, but estimates of the present level of employment are inadequate to predict the growth that will be required to meet the future needs.

The results of the EPA survey show that approximately one million people are involved in wastewater treatment. Information as to the number of full-time-equivalents employed in wastewater treatment was not collected in the EPA survey, but if it is assumed that the average effort by each employee devoted to wastewater treatment of 15 percent as reported by ESSC is correct, there are approximately 150,000 full-time-equivalent positions available in industry excluding the employees in tobacco, furniture and fixtures, leather and leather products, and miscellaneous manufacturers.

EPA and ESSC Flow Rate Models

Table 26 shows projections of the manpower engaged in wastewater treatment using the EPA and ESSC models in conjunction with mean water intake rates for process use by major industry groups. The projections using the EPA models were calculated by reading the required manpower

Table 26. Projections of manpower in thousands engaged in wastewater treatment using EPA and [illegible] models in conjunction with mean water intake rates for process use by major SIC industry groups.

SIC Code	Industry Group and Industry	EPA Models	Occupation		Laboratory				Maintenance		Instruments & Controls		Supervision			Totals
			Un-skilled	Skilled	Routine	Detailed Analyses	Special & Auto Analyses	Investigations	Un-skilled	Skilled	[illegible]	[illegible]	Foreman	Professional	Management	
			Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE	Total / FTE
20	**Food and Kindred Products**	322.3 / -	97.6 / 26	65 / 16.3	32.5 / 9.8	32.5 / 3.3	0 / 0	0 / 0	32.5 / 3.3	32.5 / 1.6	32.5 / 3.3	0 / 0	32.5 / 3.3	32.5 / 1.6	32.5 / 1.6	422.6 / 79.1
21	**Tobacco Manufacturers**	2.91 / -	0.99 / 0.26	0.66 / 0.16	0.33 / 0.1	0.33 / 0.03	0 / 0	0 / 0	0.33 / 0.03	0.33 / 0.02	0.33 / 0.03	0 / 0	0.33 / 0.03	0.33 / 0.02	0.33 / 0.02	4.29 / 0.70
22	**Textile Mill Products**	41.1 / -	14.2 / 2.1	21.2 / 2.1	14.2 / 1.4	7.08 / 1.4	7.08 / 1.4	14.2 / 0.71	28.3 / 1.4	28.3 / 2.1	7.1 / 0.7	7.1 / 2.1	21.2 / 1.4	21.2 / 2.1	7.1 / 0.70	[illegible] / 19.61
24	**Lumber and Wood Products**	141.2 / -	110.4 / 29.4	73.6 / 18.4	36.8 / 11.04	36.8 / 3.7	0 / 0	0 / 0	36.8 / 3.7	36.8 / 1.84	36.8 / 3.7	0 / 0	36.8 / 3.7	36.8 / 1.84	36.8 / 1.84	478.4 / 79.16
25	**Furniture and Fixtures**	21.8 / -	30 / 8	20 / 5	10 / 3	10 / 1	0 / 0	0 / 0	10 / 1	1 / 0.5	10 / 1	0 / 0	10 / 1	10 / 0.5	10 / 0.5	121.0 / 21.5
26	**Paper and Allied Products**	151.5 / -	58.9 / 17.7	58.9 / 17.7	47.1 / 11.8	0 / 0	0 / 0	35.3 / 3.5	0 / 0	35.3 / 10.6	0 / 0	17.7 / 1.8	17.7 / 5.9	29.5 / 3.53	5.9 / 0.12	306.3 / [illegible]
28	**Chemicals and Allied Products**	280 / -	82.6 / 8.3	82.6 / 8.3	0 / 0	47.2 / 12.4	35.4 / 4.1	0 / 0	35.4 / 6.6	23.6 / 2.95	35.4 / 12.4	47.2 / 5.3	0 / 0	35.4 / 14.2	11.8 / 1.2	436.6 / 75.75
29	**Petroleum and Coal Products**	16.1 / -	1.88 / 0.13	1.88 / 0.15	0 / 0	1.88 / 0.11	0 / 0	0 / 0	1.88 / 0.06	1.88 / 0.06	1.88 / 0.19	1.88 / 0.19	0 / 0	1.88 / 0.38	1.88 / 0.09	16.92 / 1.36
30	**Rubber and Plastics Products, Nec.**	62.3 / -	6.46 / 0.45	6.46 / 0.52	0 / 0	6.46 / 0.39	0 / 0	0 / 0	6.46 / 0.19	6.46 / 0.19	6.46 / 0.06	6.46 / 0.06	0 / 0	6.46 / 1.3	6.46 / 0.32	58.14 / 3.48
31	**Leather and Leather Products**	21.3 / -	3.69 / 0.74	3.69 / 0.74	3.69 / 1.11	3.69 / 0.37	3.69 / 0.37	3.69 / 0.37	3.69 / 0.37	7.38 / 1.11	3.69 / 0.37	3.69 / 0.74	3.69 / 0.37	3.69 / 0.74	3.69 / 0.37	51.66 / 7.77
32	**Stone, Clay, and Glass Products**	158.4 / -	46.7 / 12.5	31.2 / 7.8	15.6 / 4.7	15.6 / 1.56	0 / 0	0 / 0	15.6 / 1.56	15.6 / 0.78	15.6 / 1.56	0 / 0	15.6 / 1.56	15.6 / 0.78	15.6 / 0.78	202.7 / 33.58
33	**Primary Metal Industries**	167.6 / -	6.84 / 1.37	6.84 / 2.73	6.84 / 1.37	6.84 / 0.34	6.84 / 0.34	6.84 / 0.68	6.84 / 1.37	6.84 / 0.68	6.84 / 0.68	6.84 / 0.68	6.84 / 0.68	6.84 / 0.68	6.84 / 0.68	88.92 / 12.28
34	**Fabricated Metal Products**	120.1 / -	54.8 / 5.5	54.8 / 5.5	54.8 / 5.5	27.4 / 5.5	0 / 0	0 / 0	27.4 / 5.5	27.4 / 5.5	27.4 / 2.74	27.4 / 2.74	27.4 / 2.74	27.4 / 2.74	27.4 / 2.74	383.6 / 46.7
35	**Machinery, Except Electrical**	164.4 / -	75.8 / 7.58	75.8 / 7.58	75.8 / 7.58	37.9 / 7.58	0 / 0	0 / 0	37.9 / 7.58	37.9 / 7.58	37.9 / 3.8	37.9 / 3.8	37.9 / 3.8	37.9 / 3.8	37.9 / 3.8	530.6 / 64.48
36	**Electrical Equip. and Supplies**	49.4 / -	21.4 / 2.14	21.4 / 2.14	21.4 / 2.14	10.7 / 2.14	0 / 0	0 / 0	10.7 / 2.14	10.7 / 2.14	21.4 / 2.14	21.4 / 2.14	21.4 / 2.14	21.4 / 2.14	21.4 / 2.14	203.3 / 23.54
37	**Transportation Equipment**	41.4 / -	0 / 0	7.48 / 1.87	0 / 0	7.48 / 1.87	0 / 0	0 / 0	0 / 0	7.48 / 1.5	0 / 0	7.48 / 0.37	0 / 0	7.48 / 0.37	0 / 0	37.4 / 5.98
38	**Instruments and Related Products**	24.5 / -	0 / 0	4.45 / 1.11	0 / 0	4.45 / 1.11	0 / 0	0 / 0	0 / 0	4.45 / 0.89	0 / 0	4.45 / 0.22	0 / 0	4.45 / 0.22	0 / 0	22.25 / 3.55
39	**Misc. Manufacturing Industries**	58.5 / -	28.1 / 2.81	28.1 / 2.81	28.1 / 2.81	14.1 / 2.81	0 / 0	0 / 0	14.1 / 2.81	14.1 / 2.81	14.1 / 1.41	14.1 / 1.41	14.1 / 1.41	14.1 / 1.41	14.1 / 1.41	197.1 / 23.91
		1844.81 / -	640.36 / 124.98	564.06 / 100.91	347.16 / 62.35	270.41 / 45.61	53.01 / 6.21	60.03 / 5.26	267.9 / 37.61	[illegible] / [illegible]	[illegible] / [illegible]	[illegible] / [illegible]	[illegible] / [illegible]	312.93 / 38.35	239.7 / 18.31	[illegible] / 574.9

from the plots of the model shown in Figures 1 - 13 for the mean water intake rate for process use for each major industry group and then multiplying this value by the number of establishments in the category. Values read from the plots of the EPA models were summarized in Table 19. Projections made with the ESSC models were calculated by using the manpower requirements presented in Tables 11 - 17 according to the mean water intake rate for process use and then multiplying by the number of establishments in the category.

Table 27 shows projections of the manpower engaged in wastewater treatment using the EPA and ESSC models in conjunction with mean water intake rates for process use by subdivisions of the major industry groups. Projections using the EPA models were calculated by reading the required manpower from the plots of the models shown in Figures 1 - 13 for the mean water intake rate for process use for each subdivision of the major industry groups and then multiplying this value by the ratio of the number of establishments in each subdivision to the total number of establishments in each major industry group.

Comparison of Projections

Projections based upon the average number of employees for each industry group (Tables 20 - 25) as reported for the EPA survey yielded estimates much lower than those obtained when the same data were compared with the mean waste discharge rate models used in conjunction with the mean water intake rate for process use. Estimates based upon

Table 27. Projection of manpower in thousands engag
subdivisions of major SIC industry groups.

SIC Code	Industry Group and Industry	EPA Models	Operation						
			Unskilled		Skilled		Routine		Deta Analy
			Total	FTE	Total	FTE	Total	FTE	Total
201	Meat Products	64.4	19.3	5.15	12.87	3.22	6.43	1.93	6.43
202	Daily Products	65.2	21.55	5.75	14.36	3.59	7.18	2.15	7.18
203	Canned, Cured, and Frozen Foods	63.36	18.6	4.97	12.42	3.11	6.21	1.86	6.21
204	Grain Mill Products	11.59	3.45	0.92	2.3	0.58	1.15	0.35	1.15
205	Bakery Products	8.07	2.7	0.72	1.8	0.45	0.9	0.27	0.9
206	Sugar	24.69	10.57	2.11	5.28	1.23	3.52	0.7	1.76
207	Confectionery and Related Products	5.08	1.62	0.43	1.08	0.27	0.54	0.16	0.54
208	Beverages	41.91	13	3.46	8.66	2.17	4.33	1.3	4.33
209	Misc. Foods and Kindred Products	37.87	12	3.21	8.02	2	4	1.2	4
20	Food and Kindred Products	322.17	102.79	26.72	66.79	16.62	34.26	9.92	32.5
2111	Cigarettes	1.4	0.45	0.12	0.3	0.08	0.15	0.05	0.15
21	Tobacco Manufacturers	1.4	0.45	0.12	0.3	0.08	0.15	0.05	0.15
2211	Weaving Mills, Cotton	7.43	2.57	0.39	3.85	0.39	2.57	0.26	1.28
2221	Weaving Mills, Synthetics	4.98	1.78	0.27	2.67	0.27	1.78	0.18	0.89
2231	Weaving and Finishing Mills, Wool	3.79	1.28	0.19	1.93	0.19	1.28	0.13	0.64
2241	Narrow Fabric Mills	0.63	0.11	0.02	0.11	0.02	0.11	0.03	0.11
225	Knitting Mills	5.71	2.07	0.31	3.1	0.31	2.07	0.31	1.04
226	Textile Finishing, Except Wool	8.37	2.63	0.39	1.31	0.13	2.63	0.13	1.31
227	Floor Covering Mills	3.0	1.04	0.16	1.55	0.16	1.04	0.16	0.52
228	Yarn and Thread Mills	3.76	1.35	0.2	2	0.2	1.35	0.13	0.67
229	Miscellaneous Textile Goods	3.35	0.61	0.12	0.61	0.12	0.61	0.18	0.61
22	Textile Mill Products	41.02	13.44	2.05	17.13	1.79	13.44	1.51	7.07
242	Sawmills and Planing Mills	87.52	47.57	12.68	31.7	7.92	15.86	4.76	15.86
243	Millwork, Plywood, Related Prod.	41.02	36.4	9.71	24.3	6.07	12.14	3.64	12.14
249	Miscellaneous Wood Products	28.56	22.3	5.95	14.9	3.72	7.44	2.23	7.44
24	Lumber and Wood Products	157.1	106.27	28.34	70.9	17.71	35.44	10.63	35.44
251	Household Furniture	9.57	10.92	2.91	7.28	1.82	3.64	1.09	3.64
252	Office Furniture	6.29	6.55	1.75	4.37	1.09	2.18	0.66	2.18
259	Misc. Furniture and Fixtures	0.35	3.28	0.87	2.18	0.55	1.09	0.33	1.09
25	Furniture and Fixtures	16.21	20.75	5.53	13.83	3.46	6.91	2.08	6.91
2611	Pulpmills	22.00	2.95	0.88	2.95	0.88	2.36	0.59	0
2621	Papermills, Except Building Paper	77.93	23.7	7.11	23.7	7.11	18.95	4.74	0
2631	Paperboard Mills	44.14	17.2	5.17	17.2	5.17	13.8	3.44	0
264	Misc. Converted Paper Products	3.09	7.23	2.17	7.23	2.17	5.79	1.45	0
265	Paperboard Containers and Boxes	1.15	3.9	1.17	3.9	1.17	3.12	0.78	0
2661	Building Paper and Board Mills	3.51	3.9	1.17	3.9	1.17	3.12	0.78	0
26	Paper and Allied Products	151.82	58.88	17.67	58.88	17.67	47.14	11.78	0
281	Industrial Chemicals	184.2	42.7	0.43	42.7	0.43	0	0	24.4
282	Plastics Materials and Synthetics	42.41	8.1	0.71	12.15	6.1	8.1	0.81	2.02
283	Drugs	7.80	0.79	0.06	0.79	0.06	0	0	0.79
284	Soap, Cleaners, and Toilet Goods	6.09	0.68	0.03	0.68	0.05	0	0	0.68

engaged in wastewater treatment using EPA and ESSC models in conjunction w
roups.

Occupational Category										
Laboratory						Maintenance				Ins
Detailed Analyses		Special & Auto Analyses		Investi-gations		Unskilled		Skilled		Ro
Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total
6.43	0.64	0	0	0	0	6.43	0.64	6.43	0.32	6.4
7.18	0.72	0	0	0	0	7.18	0.72	7.18	0.36	7.1
6.21	0.62	0	0	0	0	6.21	0.62	6.21	0.31	6.2
1.15	0.12	0	0	0	0	1.15	0.12	1.15	0.06	1.1
0.9	0.09	0	0	0	0	0.9	0.09	0.9	0.05	0.9
1.76	0.18	1.76	0.09	1.76	0.09	1.76	0.35	1.76	0.18	1.7
0.54	0.05	0	0	0	0	0.54	0.05	0.54	0.03	0.5
4.33	0.43	0	0	0	0	4.33	0.43	4.33	0.22	4.3
4	0.4	0	0	0	0	4	0.4	4	0.2	4
32.5	3.25	1.76	0.09	1.76	0.09	32.5	3.42	32.5	1.73	32.5
0.15	0.02	0	0	0	0	0.15	0.02	0.15	0.01	0.1
0.15	0.02	0	0	0	0	0.15	0.02	0.15	0.01	0.1
1.28	0.26	1.28	0.26	2.57	0.13	5.13	0.26	5.13	0.39	1.2
0.89	0.18	0.89	0.18	1.78	0.09	3.56	0.18	3.56	0.27	0.8
0.64	0.13	0.64	0.13	1.28	0.06	2.57	0.13	2.57	0.19	0.6
0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.22	0.03	0.1
1.04	0.21	1.04	0.21	2.07	0.1	4.14	0.21	4.14	0.31	1.0
1.31	0.26	1.31	0.26	2.63	0.13	5.26	0.26	5.26	0.39	1.3
0.52	0.1	0.52	0.1	1.04	0.05	2.07	0.1	2.07	0.16	0.5
0.67	0.13	0.67	0.13	1.35	0.07	2.69	0.13	2.69	0.2	0.6
0.61	0.06	0.61	0.06	0.61	0.06	0.61	0.06	1.22	0.18	0.6
7.07	1.34	7.07	1.34	13.44	0.7	26.14	1.34	26.86	2.12	7.0
15.86	1.59	0	0	0	0	15.86	1.59	15.86	0.79	15.8
12.14	1.21	0	0	0	0	12.14	1.21	12.14	0.61	12.1
7.44	0.74	0	0	0	0	7.44	0.74	7.44	0.37	7.4
35.44	3.54	0	0	0	0	35.44	3.54	35.44	1.77	35.4
3.64	0.36	0	0	0	0	3.64	0.36	3.64	0.18	3.6
2.18	0.22	0	0	0	0	2.18	0.22	2.18	0.11	2.1
1.09	0.11	0	0	0	0	1.09	0.11	1.09	0.05	1.0
6.91	0.69	0	0	0	0	6.91	0.69	6.91	0.34	6.9
0	0	0	0	1.77	0.18	0	0	1.77	0.97	0
0	0	0	0	14.2	0.14	0	0	14.2	7.82	0
0	0	0	0	10.3	1.03	0	0	10.3	5.68	0
0	0	0	0	4.34	0.43	0	0	4.34	2.39	0
0	0	0	0	2.34	0.23	0	0	2.34	1.29	0
0	0	0	0	2.34	0.23	0	0	2.34	1.29	0
0	0	0	0	35.29	2.24	0	0	35.29	19.44	0
24.4	6.41	18.3	2.14	0	0	18.3	3.42	12.2	1.5	18.3
2.02	0.06	0	0	2.02	0.04	8.1	0.85	8.1	0.61	4.0
0.79	0.05	0	0	0	0	0.79	0.02	0.79	0.02	0
[illegible]	[illegible]	0	0	0	0	0.68	0.02	0.68	0.02	0
						[illegible]	[illegible]	[illegible]	[illegible]	0

ith mean water intake rates for process use by

truments & Controls			Supervision						Totals	
tine	Install-ation & Maint.		Foreman		Professional		Management			
FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE
0.64	0	0	6.43	0.64	6.43	0.32	6.43	0.32	83.61	13.82
0.72	0	0	7.18	0.72	7.18	0.36	7.18	0.36	93.35	15.45
0.62	0	0	6.21	0.62	6.21	0.31	6.21	0.31	80.7	13.35
0.12	0	0	1.15	0.1	1.15	0.06	1	0.06	14.8	2.49
0.09	0	0	0.9	0.09	0.9	0.05	0.9	0.05	11.7	1.95
0.18	1.76	0.18	1.76	0.35	1.76	0.53	1.76	0.18	36.97	6.35
0.05	0	0	0.54	0.05	0.54	0.3	0.54	0.3	7.02	1.69
0.43	0	0	4.33	0.43	4.33	0.22	4.33	0.22	56.3	9.31
0.4	0	0	4	0.4	4	0.2	4	0.2	52.02	8.61
3.25	1.76	0.18	32.5	3.4	32.5	2.35	32.35	2.0	436.47	73.02
0.02	0	0	0.15	0.02	0.15	0.01	0.15	0.01	1.95	0.36
0.02	0	0	0.15	0.02	0.15	0.01	0.15	0.01	1.95	0.36
0.13	1.28	0.39	3.85	0.26	3.85	0.39	1.28	0.13	35.92	3.64
0.09	0.89	0.27	2.67	0.18	2.67	0.27	0.89	0.09	24.92	2.52
0.06	0.64	0.19	1.92	0.13	1.92	0.19	0.64	0.06	17.95	1.78
0.01	0.11	0.02	0.11	0.01	0.11	0.02	0.11	0.01	1.54	0.21
0.1	1.04	0.31	3.11	0.21	3.11	0.31	1.04	0.1	29.01	3.0
0.13	1.31	0.39	3.94	0.26	1.31	0.13	1.31	0.13	31.52	2.99
0.05	0.52	0.16	1.55	0.1	1.55	0.16	0.52	0.05	14.51	1.51
0.07	0.67	0.2	2	0.13	2	0.2	0.67	0.07	18.78	1.86
0.06	0.61	0.12	0.61	0.06	0.61	0.12	0.61	0.06	8.54	1.26
0.7	7.07	2.05	19.76	1.34	17.13	1.79	7.07	0.7	182.69	18.77
1.59	0	0	15.86	1.59	15.86	0.79	15.86	0.79	206.15	34.09
1.21	0	0	12.14	1.21	12.14	0.61	12.14	0.61	157.82	26.09
0.74	0	0	7.44	0.74	7.44	0.37	7.44	0.37	96.72	15.97
3.54	0	0	35.44	3.54	35.44	1.77	35.44	1.77	460.69	76.15
0.36	0	0	3.64	0.36	3.64	0.18	3.64	0.18	47.32	7.8
0.22	0	0	2.18	0.22	2.18	0.11	2.18	0.11	28.36	4.71
0.11	0	0	1.09	0.11	1.09	0.05	1.09	0.05	14.18	2.34
0.69	0	0	6.91	0.69	6.91	0.34	6.91	0.34	89.86	14.85
0	0.88	0.09	0.88	0.3	1.47	0.18	0.29	0.01	15.32	4.08
0	7.11	0.71	7.11	2.37	11.8	1.42	2.37	0.05	123.14	31.47
0	5.17	0.52	5.17	1.72	8.61	1.03	1.72	0.03	89.47	23.79
0	2.17	0.22	2.17	0.72	3.62	0.43	0.72	0.01	37.61	9.99
0	1.17	0.12	1.17	0.39	1.95	0.23	0.39	0.01	20.28	5.39
0	1.17	0.12	1.17	0.39	1.95	0.23	0.39	0.01	20.28	5.39
0	17.67	1.78	17.67	5.89	29.4	3.52	5.88	0.12	306.1	80.11
6.41	24.4	2.7	0	0	18.3	7.32	6.1	0.61	225.7	31.37
0.4	0	0	0	0	6.1	1.42	2.02	0.2	60.75	11.2
0.01	0.79	0.0	0	0	0.79	0.16	0.79	0.04	6.32	0.43
[illegible]	[illegible]	0.01	0	0	0.68	0.14	0.68	0.03	5.44	0.35

Instruments	
Routine	
Total	FTE
0.53	[illegible]
2.74	[illegible]
0.56	[illegible]
3.78	[illegible]
0.35	[illegible]
0.61	[illegible]
3.03	0.3
0.45	[illegible]
3.54	[illegible]
15.59	[illegible]
10.02	1
1.11	[illegible]
0.63	[illegible]
0.16	[illegible]
1.38	[illegible]
0.42	[illegible]
0.63	[illegible]
14.35	[illegible]
1.35	[illegible]
3.66	[illegible]
1.83	[illegible]
2.94	[illegible]
2.36	[illegible]
4.19	[illegible]
5.69	[illegible]
0.96	[illegible]
4.43	[illegible]
27.41	[illegible]
2.98	0.3
2.98	0.3
5.95	0.6
5.55	[illegible]
3.14	[illegible]
7.72	[illegible]
3.45	[illegible]
4.02	[illegible]
2.09	[illegible]
37.88	[illegible]
1.01	[illegible]
1.45	[illegible]
1.28	[illegible]
1.39	[illegible]
0.65	[illegible]
1.68	[illegible]
0.17	[illegible]
1.2	[illegible]
8.83	[illegible]

206	Sugar	24.69	10.57	2.11	[illegible]	[illegible]	[illegible]	[illegible]
207	Confectionery and Related Products	5.08	1.62	0.43	1.08	0.27	0.54	0.1
208	Beverages	41.91	13	3.46	8.66	2.17	4.33	1.3
209	Misc. Foods and Kindred Products	37.87	12	3.21	8.02	2	4	1.2
20	Food and Kindred Products	322.17	102.79	26.72	66.79	16.62	34.26	9.92
2111	Cigarettes	1.4	0.45	0.12	0.3	0.08	0.15	0.05
21	Tobacco Manufacturers	1.4	0.45	0.12	0.3	0.08	0.15	0.05
2211	Weaving Mills, Cotton	7.43	2.57	0.39	3.85	0.39	2.57	0.26
2221	Weaving Mills, Synthetics	4.98	1.78	0.27	2.67	0.27	1.78	0.18
2231	Weaving and Finishing Mills, Wool	3.79	1.28	0.19	1.93	0.19	1.28	0.13
2241	Narrow Fabric Mills	0.63	0.11	0.02	0.11	0.02	0.11	0.03
225	Knitting Mills	5.71	2.07	0.31	3.1	0.31	2.07	0.31
226	Textile Finishing, Except Wool	8.37	2.63	0.39	1.31	0.13	2.63	0.13
227	Floor Covering Mills	3.0	1.04	0.16	1.55	0.16	1.04	0.16
228	Yarn and Thread Mills	3.76	1.35	0.2	2	0.2	1.35	0.13
229	Miscellaneous Textile Goods	3.35	0.61	0.12	0.61	0.12	0.61	0.18
22	Textile Mill Products	41.02	13.44	2.05	17.13	1.79	13.44	1.51
242	Sawmills and Planing Mills	87.52	47.57	12.68	31.7	7.92	15.86	4.76
243	Millwork, Plywood, Related Prod.	41.02	36.4	9.71	24.3	6.07	12.14	3.64
249	Miscellaneous Wood Products	28.56	22.3	5.95	14.9	3.72	7.44	2.23
24	Lumber and Wood Products	157.1	106.27	28.34	70.9	17.71	35.44	10.63
251	Household Furniture	9.57	10.92	2.91	7.28	1.82	3.64	1.09
252	Office Furniture	6.29	6.55	1.75	4.37	1.09	2.18	0.66
259	Misc. Furniture and Fixtures	0.35	3.28	0.87	2.18	0.55	1.09	0.33
25	Furniture and Fixtures	16.21	20.75	5.53	13.83	3.46	6.91	2.08
2611	Pulpmills	22.00	2.95	0.88	2.95	0.88	2.36	0.59
2621	Papermills, Except Building Paper	77.93	23.7	7.11	23.7	7.11	18.95	4.74
2631	Paperboard Mills	44.14	17.2	5.17	17.2	5.17	13.8	3.44
264	Misc. Converted Paper Products	3.09	7.23	2.17	7.23	2.17	5.79	1.45
265	Paperboard Containers and Boxes	1.15	3.9	1.17	3.9	1.17	3.12	0.78
2661	Building Paper and Board Mills	3.51	3.9	1.17	3.9	1.17	3.12	0.78
26	Paper and Allied Products	151.82	58.88	17.67	58.88	17.67	47.14	11.78
281	Industrial Chemicals	184.2	42.7	0.43	42.7	0.43	0	0
282	Plastics Materials and Synthetics	42.41	8.1	0.71	12.15	6.1	8.1	0.81
283	Drugs	7.80	0.79	0.06	0.79	0.06	0	0
284	Soap, Cleaners, and Toilet Goods	6.09	0.68	0.03	0.68	0.05	0	0
2851	Paints and Allied Products	3.27	0.33	0.02	0.33	0.03	0	0
2861	Gum and Wood Chemicals	1.34	0.15	0.01	0.15	0.01	0	0
287	Agricultural Chemicals	12.28	2.52	0.22	3.78	1.89	2.52	0.25
289	Miscellaneous Chemical Products	21.97	4.36	0.38	6.55	3.27	4.36	0.44
28	Chemicals and Allied Products	279.36	61.18	1.86	67.13	11.84	14.98	1.5
2911	Petroleum Refining	28.10	1.55	0.11	1.55	0.12	0	0
295	Paving and Roofing Materials	2.56	0.27	0.02	0.27	0.02	0	0
299	Misc. Petroleum and Coal Products	0.53	0.07	0	0.07	0.01	0	0
29	Petroleum and Coal Products	31.19	1.89	0.13	1.89	0.15	0	0
3011	Tires and Inner Tubes	13.21	1.14	0.08	1.14	0.09	0	0
3021	Rubber Footwear	1.26	0.15	0.01	0.15	0.01	0	0
3069	Fabricated Rubber Products, Nec.	21.28	2.32	0.16	2.32	0.19	0	0
3079	Miscellaneous Plastics Products	25.47	2.75	0.19	2.75	0.22	0	0
30	Rubber and Plastics Products, Nec.	61.22	6.36	0.44	6.36	0.51	0	0
3111	Leather Tanning and Finishing	17.60	3	0.6	3	0.6	3	0.9
314	Footwear, Except Rubber	2.56	0.48	0.1	0.48	0.1	0.48	0.1
31	Leather and Leather Products	20.16	3.48	0.7	3.48	0.7	3.48	1.0

7.18	2.15	7.18	0.72	0	0	0	0	7.18	0.72	7.18	0.36	7.1
6.21	1.86	6.21	0.62	0	0	0	0	6.21	0.62	6.21	0.31	6.2
1.15	0.35	1.15	0.12	0	0	0	0	1.15	0.12	1.15	0.06	1.1
0.9	0.27	0.9	0.09	0	0	0	0	0.9	0.09	0.9	0.05	0.9
3.52	0.7	1.76	0.18	1.76	0.09	1.76	0.09	1.76	0.35	1.76	0.18	1.7
0.54	0.16	0.54	0.05	0	0	0	0	0.54	0.05	0.54	0.03	0.5
4.33	1.3	4.33	0.43	0	0	0	0	4.33	0.43	4.33	0.22	4.3
4	1.2	4	0.4	0	0	0	0	4	0.4	4	0.2	4
34.26	9.92	32.5	3.25	1.76	0.09	1.76	0.09	32.5	3.42	32.5	1.73	32.5
0.15	0.05	0.15	0.02	0	0	0	0	0.15	0.02	0.15	0.01	0.1
0.15	0.05	0.15	0.02	0	0	0	0	0.15	0.02	0.15	0.01	0.1
2.57	0.26	1.28	0.26	1.28	0.26	2.57	0.13	5.13	0.26	5.13	0.39	1.2
1.78	0.18	0.89	0.18	0.89	0.18	1.78	0.09	3.56	0.18	3.56	0.27	0.8
1.28	0.13	0.64	0.13	0.64	0.13	1.28	0.06	2.57	0.13	2.57	0.19	0.6
0.11	0.03	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.22	0.03	0.1
2.07	0.31	1.04	0.21	1.04	0.21	2.07	0.1	4.14	0.21	4.14	0.31	1.0
2.63	0.13	1.31	0.26	1.31	0.26	2.63	0.13	5.26	0.26	5.26	0.39	1.3
1.04	0.16	0.52	0.1	0.52	0.1	1.04	0.05	2.07	0.1	2.07	0.16	0.5
1.35	0.13	0.67	0.13	0.67	0.13	1.35	0.07	2.69	0.13	2.69	0.2	0.6
0.61	0.18	0.61	0.06	0.61	0.06	0.61	0.06	0.61	0.06	1.22	0.18	0.6
13.44	1.51	7.07	1.34	7.07	1.34	13.44	0.7	26.14	1.34	26.86	2.12	7.0
15.86	4.76	15.86	1.59	0	0	0	0	15.86	1.59	15.86	0.79	15.8
12.14	3.64	12.14	1.21	0	0	0	0	12.14	1.21	12.14	0.61	12.1
7.44	2.23	7.44	0.74	0	0	0	0	7.44	0.74	7.44	0.37	7.4
35.44	10.63	35.44	3.54	0	0	0	0	35.44	3.54	35.44	1.77	35.4
3.64	1.09	3.64	0.36	0	0	0	0	3.64	0.36	3.64	0.18	3.6
2.18	0.66	2.18	0.22	0	0	0	0	2.18	0.22	2.18	0.11	2.1
1.09	0.33	1.09	0.11	0	0	0	0	1.09	0.11	1.09	0.05	1.0
6.91	2.08	6.91	0.69	0	0	0	0	6.91	0.69	6.91	0.34	6.9
2.36	0.59	0	0	0	0	1.77	0.18	0	0	1.77	0.97	0
18.95	4.74	0	0	0	0	14.2	0.14	0	0	14.2	7.82	0
13.8	3.44	0	0	0	0	10.3	1.03	0	0	10.3	5.68	0
5.79	1.45	0	0	0	0	4.34	0.43	0	0	4.34	2.39	0
3.12	0.78	0	0	0	0	2.34	0.23	0	0	2.34	1.29	0
3.12	0.78	0	0	0	0	2.34	0.23	0	0	2.34	1.29	0
47.14	11.78	0	0	0	0	35.29	2.24	0	0	35.29	19.44	0
0	0	24.4	6.41	18.3	2.14	0	0	18.3	3.42	12.2	1.5	18.3
8.1	0.81	2.02	0.06	0	0	2.02	0.04	8.1	0.85	8.1	0.61	4.0
0	0	0.79	0.05	0	0	0	0	0.79	0.02	0.79	0.02	0
0	0	0.68	0.04	0	0	0	0	0.68	0.02	0.68	0.02	0
0	0	0.33	0.02	0	0	0	0	0.33	0.01	0.33	0.01	0
0	0	0.15	0.01	0	0	0	0	0.15	0	0.15	0	0.1
2.52	0.25	0.63	0.02	0	0	0.63	0.01	2.52	0.26	2.52	0.19	1.2
4.36	0.44	1.09	0.03	0	0	1.09	0.02	4.36	0.46	4.36	0.33	2.1
14.98	1.5	38.7	6.64	25.18	2.14	3.74	0.07	35.23	5.04	29.13	2.68	25.9
0	0	1.55	0.09	0	0	0	0	1.55	0.05	1.55	0.05	1.5
0	0	0.27	0.02	0	0	0	0	0.27	0.01	0.27	0.01	0.2
0	0	0.07	0	0	0	0	0	0.07	0	0.07	0	0.0
0	0	1.89	0.11	0	0	0	0	1.89	0.06	1.89	0.06	1.8
0	0	1.14	0.07	0	0	0	0	1.14	0.03	1.14	0.03	1.1
0	0	0.15	0.01	0	0	0	0	0.15	0	0.15	0	0.1
0	0	2.32	0.14	0	0	0	0	2.32	0.07	2.32	0.07	2.3
0	0	2.75	0.16	0	0	0	0	2.75	0.08	2.75	0.08	2.7
0	0	6.36	0.38	0	0	0	0	6.36	0.18	6.36	0.18	6.3
3	0.9	3	0.3	3	0.3	3	0.3	3	0.3	6.01	0.9	3
0.48	0.14	0.48	0.05	0.48	0.05	0.48	0.05	0.48	0.05	0.96	0.14	0.4
3.48	1.04	3.48	0.35	3.48	0.35	3.48	0.35	3.48	0.35	6.97	1.09	3.4

0.18	1.76	0.18	1.76	0.35	1.76					
0.05	0	0	0.54	0.05	0.54	0.3	0.54	0.3	7.02	1.69
0.43	0	0	4.33	0.43	4.33	0.22	4.33	0.22	56.3	9.31
0.4	0	0	4	0.4	4	0.2	4	0.2	52.02	8.61
3.25	1.76	0.18	32.5	3.4	32.5	2.35	32.35	2.0	436.47	73.02
0.02	0	0	0.15	0.02	0.15	0.01	0.15	0.01	1.95	0.36
0.02	0	0	0.15	0.02	0.15	0.01	0.15	0.01	1.95	0.36
0.13	1.28	0.39	3.85	0.26	3.85	0.39	1.28	0.13	35.92	3.64
0.09	0.89	0.27	2.67	0.18	2.67	0.27	0.89	0.09	24.92	2.52
0.06	0.64	0.19	1.92	0.13	1.92	0.19	0.64	0.06	17.95	1.78
0.01	0.11	0.02	0.11	0.01	0.11	0.02	0.11	0.01	1.54	0.21
0.1	1.04	0.31	3.11	0.21	3.11	0.31	1.04	0.1	29.01	3.0
0.13	1.31	0.39	3.94	0.26	1.31	0.13	1.31	0.13	31.52	2.99
0.05	0.52	0.16	1.55	0.1	1.55	0.16	0.52	0.05	14.51	1.51
0.07	0.67	0.2	2	0.13	2	0.2	0.67	0.07	18.78	1.86
0.06	0.61	0.12	0.61	0.06	0.61	0.12	0.61	0.06	8.54	1.26
0.7	7.07	2.05	19.76	1.34	17.13	1.79	7.07	0.7	182.69	18.77
1.59	0	0	15.86	1.59	15.86	0.79	15.86	0.79	206.15	34.09
1.21	0	0	12.14	1.21	12.14	0.61	12.14	0.61	157.82	26.09
0.74	0	0	7.44	0.74	7.44	0.37	7.44	0.37	96.72	15.97
3.54	0	0	35.44	3.54	35.44	1.77	35.44	1.77	460.69	76.15
0.36	0	0	3.64	0.36	3.64	0.18	3.64	0.18	47.32	7.8
0.22	0	0	2.18	0.22	2.18	0.11	2.18	0.11	28.36	4.71
0.11	0	0	1.09	0.11	1.09	0.05	1.09	0.05	14.18	2.34
0.69	0	0	6.91	0.69	6.91	0.34	6.91	0.34	89.86	14.85
0	0.88	0.09	0.88	0.3	1.47	0.18	0.29	0.01	15.32	4.08
0	7.11	0.71	7.11	2.37	11.8	1.42	2.37	0.05	123.14	31.47
0	5.17	0.52	5.17	1.72	8.61	1.03	1.72	0.03	89.47	23.79
0	2.17	0.22	2.17	0.72	3.62	0.43	0.72	0.01	37.61	9.99
0	1.17	0.12	1.17	0.39	1.95	0.23	0.39	0.01	20.28	5.39
0	1.17	0.12	1.17	0.39	1.95	0.23	0.39	0.01	20.28	5.39
0	17.67	1.78	17.67	5.89	29.4	3.52	5.88	0.12	306.1	80.11
6.41	24.4	2.7	0	0	18.3	7.32	6.1	0.61	225.7	31.37
0.4	0	0	0	0	6.1	1.42	2.02	0.2	60.75	11.2
0.01	0.79	0.0	0	0	0.79	0.16	0.79	0.04	6.32	0.43
0.01	0.68	0.01	0	0	0.68	0.14	0.68	0.03	5.44	0.35
0	0.33	0	0	0	0.33	0.07	0.33	0.02	2.64	0.18
0	0.15	0	0	0	0.15	0.03	0.15	0.01	1.35	0.07
0.13	0	0	0	0	1.89	0.44	0.63	0.06	18.9	3.47
0.22	0	0	0	0	3.27	0.76	1.09	0.11	32.71	6.02
7.18	26.35	2.72	0	0	31.51	10.34	11.79	1.08	353.81	53.09
0.02	1.55	0.02	0	0	1.55	0.31	1.55	0.08	13.95	0.85
0	0.27	0	0	0	0.27	0.05	0.27	0.01	2.43	0.14
0	0.07	0	0	0	0.07	0.01	0.07	0	0.63	0.02
0.02	1.89	0.02	0	0	1.89	0.37	1.89	0.09	17.01	1.01
0.01	1.14	0.01	0	0	1.14	0.23	1.14	0.06	10.26	0.61
0	0.15	0	0	0	0.15	0.03	0.15	0.02	1.35	0.08
0.02	2.32	0.02	0	0	2.32	0.46	2.32	0.23	20.88	1.36
0.03	2.75	0.03	0	0	2.75	0.55	2.75	0.14	24.75	1.48
0.06	6.36	0.06	0	0	6.36	1.27	6.36	0.45	57.24	3.53
0.3	3	0.6	3	0.3	3	0.6	3	0.3	42.01	6.3
0.05	0.48	0.1	0.48	0.05	0.48	0.1	0.48	0.05	6.72	1.03
0.35	3.48	0.7	3.48	0.35	3.48	0.7	3.48	0.35	48.73	7.33

0.63	0.06
0.16	0.02
1.38	0.14
0.42	0.04
0.63	0.06
14.35	1.43
1.35	0.07
3.66	0.37
1.83	0.18
2.94	0.15
2.36	0.24
4.19	0.42
5.69	0.57
0.96	0.1
4.43	0.44
27.41	2.54
2.98	0.3
2.98	0.3
5.95	0.6
5.55	0.28
3.14	0.31
7.72	0.39
3.45	0.34
4.02	0.4
2.09	0.21
37.88	3.13
1.01	0.1
1.45	0.14
1.28	0.13
1.39	0.14
0.65	0.06
1.68	0.17
0.17	0.01
1.2	0.12
8.83	0.87
4.14	0.41
0	0
0.61	0.09
4.75	0.5
0	0
1.33	0.2
0	0
0.83	0.12
0	0
1.08	0.27
0.67	0.1
3.91	0.69
2.74	0.27
3.48	0.35
1.6	0.08
2.76	0.28
3.19	0.32
13.77	1.3
246.22	27.82

SIC Code	Industry Group and Industry	EPA Models	Operation					
			Unskilled		Skilled		Routine	
			Total	FTE	Total	FTE	Total	FTE
3211	Flat Glass	6.68	3.19	0.64	1.6	0.37	1.06	0.21
322	Glass, Glassware, Pressed or Blown	25.24	8.21	2.19	5.48	1.37	2.74	0.82
3231	Products of Purchased Glass	5.38	1.67	0.45	1.12	0.28	0.56	0.17
3241	Cement, Hydraulic	38.28	11.33	3.02	7.55	1.89	3.78	1.13
325	Structural Clay Products	3.11	1.04	0.28	0.69	0.17	0.35	0.1
326	Pottery and Related Products	5.51	1.84	0.49	1.22	0.31	0.61	0.18
327	Concrete, Gypsum, Plaster Products	29.73	9.09	2.42	6.06	1.52	3.03	0.91
3281	Cut Stone and Stone Products	2.62	1.36	0.36	0.9	0.23	0.45	0.14
329	Misc. Nonmetallic Mineral Products	21.36	10.61	2.83	7.07	1.77	3.54	1.06
32	Stone, Clay, and Glass Products	137.91	48.34	12.68	31.69	7.91	16.12	4.72
331	Blast Furnace, Basic Steel Prod.	105.62	7.51	1	7.51	1.5	7.51	0.5
332	Iron and Steel Foundries	13.77	1.11	0.22	1.11	0.44	1.11	0.22
333	Primary Nonferrous Metals	13.87	0.63	0.13	0.63	0.25	0.63	0.13
3341	Secondary Nonferrous Metals	1.98	0.16	0.03	0.16	0.07	0.16	0.03
335	Nonferrous Rolling and Drawing	19.47	1.38	0.28	1.38	0.55	1.38	0.28
336	Nonferrous Foundries	5.38	0.42	0.08	0.42	0.17	0.42	0.08
339	Misc. Primary Metal Products	7.61	0.63	0.13	0.63	0.25	0.63	0.13
33	Primary Metal Industries	167.7	11.84	1.87	11.84	3.23	11.84	1.37
3411	Metal Cans	5.00	1.35	0.13	1.35	0.13	1.35	0.13
342	Cultery, Handtools, and Hardware	18.02	7.32	0.73	7.32	0.73	7.32	0.73
343	Plumbing and Heating Exc. Electrical	8.44	3.66	0.37	3.66	0.37	3.66	0.37
344	Fabricated Structural Metal Prod.	11.70	2.94	0.29	2.94	0.29	2.94	0.29
345	Screw Machine Products, Bolts, Etc.	10.77	4.72	0.47	4.72	0.47	4.72	0.47
3461	Metal Stampings	19.70	8.38	0.84	8.38	0.84	8.38	0.84
347	Metal Services, Nec.	24.68	11.37	1.14	11.37	1.14	11.37	1.14
3481	Misc. Fabricated Wire Products	3.92	1.93	0.19	1.93	0.19	1.93	0.19
349	Misc. Fabricated Metal Products	18.04	8.87	0.89	8.87	0.89	8.87	0.89
34	Fabricated Metal Products	120.27	50.54	5.05	50.54	5.05	50.54	5.05
351	Engines and Turbines	15.30	5.95	0.6	5.95	0.6	5.95	0.6
3522	Farm Machinery	15.84	5.95	0.6	5.95	0.6	5.95	0.6
353	Construction and Related Machinery	27.98	11.91	1.19	11.91	1.19	11.91	1.19
354	Metalworking Machinery	21.54	5.55	0.56	5.55	0.56	5.55	0.56
355	Special Industry Machinery	12.77	6.28	0.63	6.28	0.63	6.28	0.63
356	General Industrial Machinery	30.20	7.72	0.77	7.72	0.77	7.72	0.77
357	Office and Computing Machines	14.34	6.9	0.69	6.9	0.69	6.9	0.69
358	Service Industry Machines	17.10	8.05	0.8	8.05	0.8	8.05	0.8
3599	Misc. Machinery, Except Electrical	9.16	4.18	0.42	4.18	0.42	4.18	0.42
35	Machinery, Except Electrical	164.23	62.49	6.26	62.49	6.26	62.49	6.26
361	Electric Test, Distributing Equip.	4.20	2.02	0.2	2.02	0.2	2.02	0.2
362	Electrical Industrial Apparatus	6.28	2.9	0.29	2.9	0.29	2.9	0.29
363	Household Appliances	8.38	2.55	0.26	2.55	0.26	2.55	0.26
364	Elect. Lighting, and Wiring Equip.	5.91	2.78	0.28	2.78	0.28	2.78	0.28
365	Radio and TV Receiving Equipment	2.72	1.3	0.13	1.3	0.13	1.3	0.13
366	Communication Equipment	7.04	3.35	0.34	3.35	0.34	3.35	0.34
3671	Electron Tubes, Receiving Type	0.68	0.17	0.02	0.17	0.02	0.17	0.02
369	Misc. Electrical Equip., Supplies	5.42	2.4	0.24	2.4	0.24	2.4	0.24

Occupational Category													
Laboratory						Maintenance				Instruments & Controls			
Detailed Analyses		Special & Auto Analyses		Investigations		Unskilled		Skilled		Routine		Installation & Maint.	
Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE
0.53	0.05	0.53	0.03	0.53	0.03	0.53	0.11	0.53	0.05	0.53	0.05	0.53	0.05
2.74	0.27	0	0	0	0	2.74	0.27	2.74	0.14	2.74	0.27	0	0
0.56	0.06	0	0	0	0	0.56	0.06	0.56	0.03	0.56	0.06	0	0
3.78	0.38	0	0	0	0	3.78	0.38	3.78	0.19	3.78	0.38	0	0
0.35	0.03	0	0	0	0	0.35	0.03	0.35	0.02	0.35	0.03	0	0
0.61	0.06	0	0	0	0	0.61	0.06	0.61	0.03	0.61	0.06	0	0
3.03	0.3	0	0	0	0	3.03	0.3	3.03	0.15	3.03	0.3	0	0
0.45	0.05	0	0	0	0	0.45	0.05	0.45	0.02	0.45	0.05	0	0
3.54	0.35	0	0	0	0	3.54	0.35	3.54	0.18	3.54	0.35	0	0
15.59	1.55	0.53	0.03	0.53	0.03	15.59	0.61	15.59	0.81	15.59	1.55	0.53	0.05
2.5	0.75	2.5	0.5	0	0	17.53	2	5.01	0.75	10.02	1	2.5	1
1.11	0.06	1.11	0.06	1.11	0.11	1.11	0.22	1.11	0.11	1.11	0.11	1.11	0.11
0.63	0.03	0.63	0.03	0.63	0.06	0.63	0.13	0.63	0.06	0.63	0.06	0.63	0.06
0.16	0.01	0.16	0.01	0.16	0.02	0.16	0.03	0.16	0.02	0.16	0.02	0.16	0.02
1.38	0.07	1.38	0.07	1.38	0.14	1.38	0.28	1.38	0.14	1.38	0.14	1.38	0.14
0.42	0.02	0.42	0.02	0.42	0.04	0.42	0.08	0.42	0.04	0.42	0.04	0.42	0.04
0.63	0.03	0.63	0.03	0.63	0.06	0.63	0.13	0.63	0.06	0.63	0.06	0.63	0.06
6.83	0.97	6.83	0.72	4.33	0.43	21.86	2.87	9.34	1.18	14.35	1.43	6.83	1.43
1.35	0.27	0	0	0	0	1.35	0.13	1.35	0.27	1.35	0.07	1.35	0.13
3.66	0.73	0	0	0	0	3.66	0.73	3.66	0.73	3.66	0.37	3.66	0.37
1.83	0.37	0	0	0	0	1.83	0.37	1.83	0.37	1.83	0.18	1.83	0.18
2.94	0.59	0	0	0	0	2.94	0.29	2.94	0.59	2.94	0.15	2.94	0.29
2.36	0.47	0	0	0	0	2.36	0.47	2.36	0.47	2.36	0.24	2.36	0.24
4.19	0.84	0	0	0	0	4.19	0.84	4.19	0.84	4.19	0.42	4.19	0.42
5.69	1.14	0	0	0	0	5.69	1.14	5.69	1.14	5.69	0.57	5.69	0.57
0.96	0.19	0	0	0	0	0.96	0.19	0.96	0.19	0.96	0.1	0.96	0.1
4.43	0.89	0	0	0	0	4.43	0.89	4.43	0.89	4.43	0.44	4.43	0.44
27.41	5.49	0	0	0	0	27.41	5.05	27.41	5.49	27.41	2.54	27.41	2.74
2.98	0.6	0	0	0	0	2.98	0.6	2.98	0.6	2.98	0.3	2.98	0.3
2.98	0.6	0	0	0	0	2.98	0.6	2.98	0.6	2.98	0.3	2.98	0.3
5.95	1.19	0	0	0	0	5.95	1.19	5.95	1.19	5.95	0.6	5.95	0.6
5.55	1.11	0	0	0	0	5.55	0.56	5.55	1.11	5.55	0.28	5.55	0.56
3.14	0.63	0	0	0	0	3.14	0.63	3.14	0.63	3.14	0.31	3.14	0.31
7.72	1.54	0	0	0	0	7.72	0.77	7.72	1.54	7.72	0.39	7.72	0.77
3.45	0.69	0	0	0	0	3.45	0.69	3.45	0.69	3.45	0.34	3.45	0.34
4.02	0.8	0	0	0	0	4.02	0.8	4.02	0.8	4.02	0.4	4.02	0.4
2.09	0.42	0	0	0	0	2.09	0.42	2.09	0.42	2.09	0.21	2.09	0.21
37.88	7.58	0	0	0	0	37.88	6.26	37.88	7.58	37.88	3.13	37.88	3.79
1.01	0.2	0	0	0	0	1.01	0.2	1.01	0.2	1.01	0.1	1.01	0.1
1.45	0.29	0	0	0	0	1.45	0.29	1.45	0.29	1.45	0.14	1.45	0.14
1.28	0.26	0	0	0	0	1.28	0.26	1.28	0.26	1.28	0.13	1.28	0.13
1.39	0.28	0	0	0	0	1.39	0.28	1.39	0.28	1.39	0.14	1.39	0.14
0.65	0.13	0	0	0	0	0.65	0.13	0.65	0.13	0.65	0.06	0.65	0.06
1.68	0.34	0	0	0	0	1.68	0.34	1.68	0.34	1.68	0.17	1.68	0.17
0.17	0.03	0	0	0	0	0.17	0.02	0.17	0.03	0.17	0.01	0.17	0.02
1.2	0.24	0	0	0	0	1.2	0.24	1.2	0.24	1.2	0.12	1.2	0.12
8.83	1.77	0	0	0	0	8.83	1.76	8.83	1.77	8.83	0.87	8.83	0.88
4.14	0.41	4.14	0.21	4.14	0.21	4.14	0.41	0	0	4.14	0.41	4.14	0.21
2.18	0.54	0	0	0	0	0	0	2.18	0.44	0	0	2.18	0.11
0.61	0.06	4.89	0.05	4.89	0.04	0	0	0.61	0.12	0.61	0.09	0	0
6.93	1.01	9.03	0.26	9.03	0.25	4.14	0.41	2.79	0.56	4.75	0.5	6.32	0.32

ategory													
ce		Instruments & Controls				Supervision							
Skilled		Routine		Install-ation & Maint.		Foreman		Professional		Management		Totals	
al	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE	Total	FTE
.53	0.05	0.53	0.05	0.53	0.05	0.53	0.11	0.53	0.16	0.53	0.03	11.15	1.89
.74	0.14	2.74	0.27	0	0	2.74	0.27	2.74	0.14	2.74	0.14	35.61	5.88
.56	0.03	0.56	0.06	0	0	0.56	0.06	0.56	0.03	0.56	0.03	7.27	1.23
.78	0.19	3.78	0.38	0	0	3.78	0.38	3.78	0.19	3.78	0.19	49.12	8.13
.35	0.02	0.35	0.03	0	0	0.35	0.03	0.35	0.02	0.35	0.02	4.53	0.73
.61	0.03	0.61	0.06	0	0	0.61	0.06	0.61	0.03	0.61	0.03	7.94	1.31
.03	0.15	3.03	0.3	0	0	3.03	0.3	3.03	0.15	3.03	0.15	39.39	6.5
.45	0.02	0.45	0.05	0	0	0.45	0.05	0.45	0.02	0.45	0.02	5.86	0.99
.54	0.18	3.54	0.35	0	0	3.54	0.35	3.54	0.18	3.54	0.18	46.0	7.6
.59	0.81	15.59	1.55	0.53	0.05	15.59	1.61	15.59	0.92	15.59	0.79	206.87	34.26
.01	0.75	10.02	1	2.5	1	7.51	0.5	2.5	1.25	2.5	0.25	75.1	11
.11	0.11	1.11	0.11	1.11	0.11	1.11	0.11	1.11	0.11	1.11	0.11	14.43	1.99
.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	8.19	1.12
.16	0.02	0.16	0.02	0.16	0.02	0.16	0.02	0.16	0.02	0.16	0.02	2.08	0.32
.38	0.14	1.38	0.14	1.38	0.14	1.38	0.14	1.38	0.14	1.38	0.14	17.94	2.51
42	0.04	0.42	0.04	0.42	0.04	0.42	0.04	0.42	0.04	0.42	0.04	5.46	0.73
63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	8.19	1.12
34	1.18	14.35	1.43	6.83	1.43	11.84	0.93	6.83	1.68	6.83	0.68	131.39	18.79
35	0.27	1.35	0.07	1.35	0.13	1.35	0.13	1.35	0.13	1.35	0.07	14.85	1.59
66	0.73	3.66	0.37	3.66	0.37	3.66	0.37	3.66	0.37	3.66	0.37	51.24	6.23
83	0.37	1.83	0.18	1.83	0.18	1.83	0.18	1.83	0.18	1.83	0.18	25.62	3.12
94	0.59	2.94	0.15	2.94	0.29	2.94	0.29	2.94	0.29	2.94	0.15	32.34	3.51
36	0.47	2.36	0.24	2.36	0.24	2.36	0.24	2.36	0.24	2.36	0.24	33.04	4.02
19	0.84	4.19	0.42	4.19	0.42	4.19	0.42	4.19	0.42	4.19	0.42	58.66	7.14
69	1.14	5.69	0.57	5.69	0.57	5.69	0.57	5.69	0.57	5.69	0.57	79.63	9.69
96	0.19	0.96	0.1	0.96	0.1	0.96	0.1	0.96	0.1	0.96	0.1	13.47	1.64
43	0.89	4.43	0.44	4.43	0.44	4.43	0.44	4.43	0.44	4.43	0.44	62.05	7.54
41	5.49	27.41	2.54	27.41	2.74	27.41	2.74	27.41	2.74	27.41	2.54	370.9	44.48
98	0.6	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	41.69	5.1
98	0.6	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	41.69	5.1
95	1.19	5.95	0.6	5.95	0.6	5.95	0.6	5.95	0.6	5.95	0.6	83.33	10.14
55	1.11	5.55	0.28	5.55	0.56	5.55	0.56	5.55	0.56	5.55	0.28	61.05	6.7
14	0.63	3.14	0.31	3.14	0.31	3.14	0.31	3.14	0.31	3.14	0.31	43.96	5.33
72	1.54	7.72	0.39	7.72	0.77	7.72	0.77	7.72	0.77	7.72	0.39	84.92	9.25
45	0.69	3.45	0.34	3.45	0.34	3.45	0.34	3.45	0.34	3.45	0.34	48.3	5.84
02	0.8	4.02	0.4	4.02	0.4	4.02	0.4	4.02	0.4	4.02	0.4	56.31	6.8
09	0.42	2.09	0.21	2.09	0.21	2.09	0.21	2.09	0.21	2.09	0.21	29.26	3.57
88	7.58	37.88	3.13	37.88	3.79	37.88	3.79	37.88	3.79	37.88	3.13	490.51	57.83
01	0.2	1.01	0.1	1.01	0.1	1.01	0.1	1.01	0.1	1.01	0.1	14.14	1.7
45	0.29	1.45	0.14	1.45	0.14	1.45	0.14	1.45	0.14	1.45	0.14	20.3	2.44
28	0.26	1.28	0.13	1.28	0.13	1.28	0.13	1.28	0.13	1.28	0.13	17.89	2.21
39	0.28	1.39	0.14	1.39	0.14	1.39	0.14	1.39	0.14	1.39	0.14	19.46	2.38
65	0.13	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	9.1	1.08
68	0.34	1.68	0.17	1.68	0.17	1.68	0.17	1.68	0.17	1.68	0.17	23.49	2.89
17	0.03	0.17	0.01	0.17	0.02	0.17	0.02	0.17	0.02	0.17	0.01	1.87	0.22
2	0.24	1.2	0.12	1.2	0.12	1.2	0.12	1.2	0.12	1.2	0.12	16.8	2.04
[illegible]	1.77	8.83	0.87	8.83	0.88	8.83	0.88	8.83	0.88	8.83	0.87	123.05	14.96

32	Stone, Clay, and Glass Products	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
331	Blast Furnace, Basic Steel Prod.	105.62	7.51	1	7.51	1.5	7.51	0.5	2.
332	Iron and Steel Foundries	13.77	1.11	0.22	1.11	0.44	1.11	0.22	1.1
333	Primary Nonferrous Metals	13.87	0.63	0.13	0.63	0.25	0.63	0.13	0.6
3341	Secondary Nonferrous Metals	1.98	0.16	0.03	0.16	0.07	0.16	0.03	0.1
335	Nonferrous Rolling and Drawing	19.47	1.38	0.28	1.38	0.55	1.38	0.28	1.
336	Nonferrous Foundries	5.38	0.42	0.08	0.42	0.17	0.42	0.08	0.
339	Misc. Primary Metal Products	7.61	0.63	0.13	0.63	0.25	0.63	0.13	0.6
33	Primary Metal Industries	167.7	11.84	1.87	11.84	3.23	11.84	1.37	6.8
3411	Metal Cans	5.00	1.35	0.13	1.35	0.13	1.35	0.13	1.
342	Cultery, Handtools, and Hardware	18.02	7.32	0.73	7.32	0.73	7.32	0.73	3.
343	Plumbing and Heating Exc. Electrical	8.44	3.66	0.37	3.66	0.37	3.66	0.37	1.
344	Fabricated Structural Metal Prod.	11.70	2.94	0.29	2.94	0.29	2.94	0.29	2.
345	Screw Machine Products, Bolts, Etc.	10.77	4.72	0.47	4.72	0.47	4.72	0.47	2.
3461	Metal Stampings	19.70	8.38	0.84	8.38	0.84	8.38	0.84	4.1
347	Metal Services, Nec.	24.68	11.37	1.14	11.37	1.14	11.37	1.14	5.
3481	Misc. Fabricated Wire Products	3.92	1.93	0.19	1.93	0.19	1.93	0.19	0.
349	Misc. Fabricated Metal Products	18.04	8.87	0.89	8.87	0.89	8.87	0.89	4.
34	Fabricated Metal Products	120.27	50.54	5.05	50.54	5.05	50.54	5.05	27.
351	Engines and Turbines	15.30	5.95	0.6	5.95	0.6	5.95	0.6	2.
3522	Farm Machinery	15.84	5.95	0.6	5.95	0.6	5.95	0.6	2.
353	Construction and Related Machinery	27.98	11.91	1.19	11.91	1.19	11.91	1.19	5.
354	Metalworking Machinery	21.54	5.55	0.56	5.55	0.56	5.55	0.56	5.
355	Special Industry Machinery	12.77	6.28	0.63	6.28	0.63	6.28	0.63	3.
356	General Industrial Machinery	30.20	7.72	0.77	7.72	0.77	7.72	0.77	7.
357	Office and Computing Machines	14.34	6.9	0.69	6.9	0.69	6.9	0.69	3.
358	Service Industry Machines	17.10	8.05	0.8	8.05	0.8	8.05	0.8	4.
3599	Misc. Machinery, Except Electrical	9.16	4.18	0.42	4.18	0.42	4.18	0.42	2.
35	Machinery, Except Electrical	164.23	62.49	6.26	62.49	6.26	62.49	6.26	37.
361	Electric Test, Distributing Equip.	4.20	2.02	0.2	2.02	0.2	2.02	0.2	1.
362	Electrical Industrial Apparatus	6.28	2.9	0.29	2.9	0.29	2.9	0.29	1.
363	Household Appliances	8.38	2.55	0.26	2.55	0.26	2.55	0.26	1.
364	Elect. Lighting, and Wiring Equip.	5.91	2.78	0.28	2.78	0.28	2.78	0.28	1.
365	Radio and TV Receiving Equipment	2.72	1.3	0.13	1.3	0.13	1.3	0.13	0.
366	Communication Equipment	7.04	3.35	0.34	3.35	0.34	3.35	0.34	1.
3671	Electron Tubes, Receiving Type	0.68	0.17	0.02	0.17	0.02	0.17	0.02	0.
369	Misc. Electrical Equip., Supplies	5.42	2.4	0.24	2.4	0.24	2.4	0.24	1.
36	Electrical Equip. and Supplies	39.18	17.47	1.76	17.47	1.76	17.47	1.76	8.
371	Motor Vehicles and Equipment	24.81	4.14	4.14	4.14	1.04	4.14	0.41	4.
372	Aircraft and Parts	11.77	0	0	2.18	0.54	0	0	2.
373	Ship and Boat Building, Repairing	2.60	0	0	0.61	0.49	0.61	0.12	0.
37	Transportation Equipment	39.18	4.14	4.14	6.93	2.07	4.75	0.53	6.
3811	Engineering, Scientific Instruments	1.30	0	0	0.33	0.17	0	0	0.
382	Mechan. Measuring, Control Devices	5.95	0	0	1.33	1.07	1.33	0.27	1.
3831	Optical Instruments and Lenses	0.95	0	0	0.25	0.13	0	0	0.
384	Medical Instruments and Supplies	3.49	0	0	0.83	0.67	0.83	0.17	0.
3851	Ophthalmic Goods	1.44	0	0	0.29	0.07	0	0	0.
3861	Photographic Equipment and Supplies	9.19	1.08	1.08	5.41	3.25	5.41	1.08	1.
387	Watches, Clocks, and Watchcases	2.11	0.33	0.27	0.67	0.5	0.33	0.13	0.
38	Instruments and Related Products	24.43	1.41	1.35	9.11	5.86	7.9	1.65	4.
391	Jewelry, Silverware, Plated Ware	11.41	5.49	0.55	5.49	0.55	5.49	0.55	2.
394	Toys and Sporting Goods	14.49	6.96	0.7	6.96	0.7	6.96	0.7	3.
395	Pens, Pencils, Office, Art Goods	5.89	1.6	0.16	1.6	0.16	1.6	0.16	1.
396	Costume Jewelry and Notions	11.96	5.51	0.55	5.51	0.55	5.51	0.55	2.
399	Miscellaneous Manufacturers	14.27	6.38	0.64	6.38	0.64	6.38	0.64	3.
39	Misc. Manufacturing Industries	58.02	25.94	2.6	25.94	2.6	25.94	2.6	13.
Total		1793.39	596.11	119.27	522.7	105.27	352.85	62.45	245.

0.5	2.5	0.75	2.5	0.5	0	0	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.22	1.11	0.06	1.11	0.06	1.11	0.11	1.11	0.22	1.11	0.11	1.11	0.11	1.11
0.13	0.63	0.03	0.63	0.03	0.63	0.06	0.63	0.13	0.63	0.06	0.63	0.06	0.63
0.03	0.16	0.01	0.16	0.01	0.16	0.02	0.16	0.03	0.16	0.02	0.16	0.02	0.16
0.28	1.38	0.07	1.38	0.07	1.38	0.14	1.38	0.28	1.38	0.14	1.38	0.14	1.38
0.08	0.42	0.02	0.42	0.02	0.42	0.04	0.42	0.08	0.42	0.04	0.42	0.04	0.42
0.13	0.63	0.03	0.63	0.03	0.63	0.06	0.63	0.13	0.63	0.06	0.63	0.06	0.63
1.37	6.83	0.97	6.83	0.72	4.33	0.43	21.86	2.87	9.34	1.18	14.35	1.43	6.83
0.13	1.35	0.27	0	0	0	0	1.35	0.13	1.35	0.27	1.35	0.07	1.35
0.73	3.66	0.73	0	0	0	0	3.66	0.73	3.66	0.73	3.66	0.37	3.66
0.37	1.83	0.37	0	0	0	0	1.83	0.37	1.83	0.37	1.83	0.18	1.83
0.29	2.94	0.59	0	0	0	0	2.94	0.29	2.94	0.59	2.94	0.15	2.94
0.47	2.36	0.47	0	0	0	0	2.36	0.47	2.36	0.47	2.36	0.24	2.36
0.84	4.19	0.84	0	0	0	0	4.19	0.84	4.19	0.84	4.19	0.42	4.19
1.14	5.69	1.14	0	0	0	0	5.69	1.14	5.69	1.14	5.69	0.57	5.69
0.19	0.96	0.19	0	0	0	0	0.96	0.19	0.96	0.19	0.96	0.1	0.96
0.89	4.43	0.89	0	0	0	0	4.43	0.89	4.43	0.89	4.43	0.44	4.43
5.05	27.41	5.49	0	0	0	0	27.41	5.05	27.41	5.49	27.41	2.54	27.41
0.6	2.98	0.6	0	0	0	0	2.98	0.6	2.98	0.6	2.98	0.3	2.98
0.6	2.98	0.6	0	0	0	0	2.98	0.6	2.98	0.6	2.98	0.3	2.98
1.19	5.95	1.19	0	0	0	0	5.95	1.19	5.95	1.19	5.95	0.6	5.95
0.56	5.55	1.11	0	0	0	0	5.55	0.56	5.55	1.11	5.55	0.28	5.55
0.63	3.14	0.63	0	0	0	0	3.14	0.63	3.14	0.63	3.14	0.31	3.14
0.77	7.72	1.54	0	0	0	0	7.72	0.77	7.72	1.54	7.72	0.39	7.72
0.69	3.45	0.69	0	0	0	0	3.45	0.69	3.45	0.69	3.45	0.34	3.45
0.8	4.02	0.8	0	0	0	0	4.02	0.8	4.02	0.8	4.02	0.4	4.02
0.42	2.09	0.42	0	0	0	0	2.09	0.42	2.09	0.42	2.09	0.21	2.09
6.26	37.88	7.58	0	0	0	0	37.88	6.26	37.88	7.58	37.88	3.13	37.88
0.2	1.01	0.2	0	0	0	0	1.01	0.2	1.01	0.2	1.01	0.1	1.01
0.29	1.45	0.29	0	0	0	0	1.45	0.29	1.45	0.29	1.45	0.14	1.45
0.26	1.28	0.26	0	0	0	0	1.28	0.26	1.28	0.26	1.28	0.13	1.28
0.28	1.39	0.28	0	0	0	0	1.39	0.28	1.39	0.28	1.39	0.14	1.39
0.13	0.65	0.13	0	0	0	0	0.65	0.13	0.65	0.13	0.65	0.06	0.65
0.34	1.68	0.34	0	0	0	0	1.68	0.34	1.68	0.34	1.68	0.17	1.68
0.02	0.17	0.03	0	0	0	0	0.17	0.02	0.17	0.03	0.17	0.01	0.17
0.24	1.2	0.24	0	0	0	0	1.2	0.24	1.2	0.24	1.2	0.12	1.2
1.76	8.83	1.77	0	0	0	0	8.83	1.76	8.83	1.77	8.83	0.87	8.83
0.41	4.14	0.41	4.14	0.21	4.14	0.21	4.14	0.41	0	0	4.14	0.41	4.14
0	2.18	0.54	0	0	0	0	0	0	2.18	0.44	0	0	2.18
0.12	0.61	0.06	4.89	0.05	4.89	0.04	0	0	0.61	0.12	0.61	0.09	0
0.53	6.93	1.01	9.03	0.26	9.03	0.25	4.14	0.41	2.79	0.56	4.75	0.5	6.32
0	0.33	0.03	0.33	0.02	0.33	0.02	0	0	0.33	0.03	0	0	0.33
0.27	1.33	0.13	10.66	0.11	10.66	0.09	0	0	1.33	0.27	1.33	0.2	0
0	0.25	0.03	0.25	0.01	0.25	0.01	0	0	0.25	0.03	0	0	0.25
0.17	0.83	0.08	6.66	0.07	6.66	0.06	0	0	0.83	0.17	0.83	0.12	0
0	0.29	0.07	0	0	0	0	0	0	0.29	0.06	0	0	0.29
1.08	1.08	0.16	1.08	0.16	1.08	0.16	5.41	0.54	0	0	1.08	0.27	1.08
0.13	0.33	0.03	0.33	0.02	0.33	0.02	0.33	0.07	0.67	0.07	0.67	0.1	0
1.65	4.44	0.53	19.31	0.39	19.31	0.35	5.74	0.61	3.7	0.63	3.91	0.69	1.95
0.55	2.74	0.55	0	0	0	0	2.74	0.55	2.74	0.55	2.74	0.27	2.74
0.7	3.48	0.7	0	0	0	0	3.48	0.7	3.48	0.7	3.48	0.35	3.48
0.16	1.6	0.32	0	0	0	0	1.6	0.16	1.6	0.32	1.6	0.08	1.6
0.55	2.76	0.55	0	0	0	0	2.76	0.55	2.76	0.55	2.76	0.28	2.76
0.64	3.19	0.64	0	0	0	0	3.19	0.64	3.19	0.64	3.19	0.32	3.19
2.6	13.77	2.76	0	0	0	0	13.77	2.6	13.77	2.76	13.77	1.3	13.77
62.45	245.57	37.98	66.31	5.32	90.91	4.52	283.32	35.81	300.81	50.15	246.22	27.82	168.1

		1	2.5	1	7.91	0.5	2.5	1.25	2.5	0.25	75.1	11
.11	1.11	0.11	1.11	0.11	1.11	0.11	1.11	0.11	1.11	0.11	14.43	1.99
.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	8.19	1.12
0.02	0.16	0.02	0.16	0.02	0.16	0.02	0.16	0.02	0.16	0.02	2.08	0.32
0.14	1.38	0.14	1.38	0.14	1.38	0.14	1.38	0.14	1.38	0.14	17.94	2.51
0.04	0.42	0.04	0.42	0.04	0.42	0.04	0.42	0.04	0.42	0.04	5.46	0.73
0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	0.63	0.06	8.19	1.12
1.18	14.35	1.43	6.83	1.43	11.84	0.93	6.83	1.68	6.83	0.68	131.39	18.79
0.27	1.35	0.07	1.35	0.13	1.35	0.13	1.35	0.13	1.35	0.07	14.85	1.59
0.73	3.66	0.37	3.66	0.37	3.66	0.37	3.66	0.37	3.66	0.37	51.24	6.23
0.37	1.83	0.18	1.83	0.18	1.83	0.18	1.83	0.18	1.83	0.18	25.62	3.12
0.59	2.94	0.15	2.94	0.29	2.94	0.29	2.94	0.29	2.94	0.15	32.34	3.51
0.47	2.36	0.24	2.36	0.24	2.36	0.24	2.36	0.24	2.36	0.24	33.04	4.02
0.84	4.19	0.42	4.19	0.42	4.19	0.42	4.19	0.42	4.19	0.42	58.66	7.14
1.14	5.69	0.57	5.69	0.57	5.69	0.57	5.69	0.57	5.69	0.57	79.63	9.69
0.19	0.96	0.1	0.96	0.1	0.96	0.1	0.96	0.1	0.96	0.1	13.47	1.64
0.89	4.43	0.44	4.43	0.44	4.43	0.44	4.43	0.44	4.43	0.44	62.05	7.54
5.49	27.41	2.54	27.41	2.74	27.41	2.74	27.41	2.74	27.41	2.54	370.9	44.48
0.6	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	41.69	5.1
0.6	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	2.98	0.3	41.69	5.1
1.19	5.95	0.6	5.95	0.6	5.95	0.6	5.95	0.6	5.95	0.6	83.33	10.14
1.11	5.55	0.28	5.55	0.56	5.55	0.56	5.55	0.56	5.55	0.28	61.05	6.7
0.63	3.14	0.31	3.14	0.31	3.14	0.31	3.14	0.31	3.14	0.31	43.96	5.33
1.54	7.72	0.39	7.72	0.77	7.72	0.77	7.72	0.77	7.72	0.39	84.92	9.25
0.69	3.45	0.34	3.45	0.34	3.45	0.34	3.45	0.34	3.45	0.34	48.3	5.84
0.8	4.02	0.4	4.02	0.4	4.02	0.4	4.02	0.4	4.02	0.4	56.31	6.8
0.42	2.09	0.21	2.09	0.21	2.09	0.21	2.09	0.21	2.09	0.21	29.26	3.57
7.58	37.88	3.13	37.88	3.79	37.88	3.79	37.88	3.79	37.88	3.13	490.51	57.83
0.2	1.01	0.1	1.01	0.1	1.01	0.1	1.01	0.1	1.01	0.1	14.14	1.7
0.29	1.45	0.14	1.45	0.14	1.45	0.14	1.45	0.14	1.45	0.14	20.3	2.44
0.26	1.28	0.13	1.28	0.13	1.28	0.13	1.28	0.13	1.28	0.13	17.89	2.21
0.28	1.39	0.14	1.39	0.14	1.39	0.14	1.39	0.14	1.39	0.14	19.46	2.38
0.13	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	0.65	0.06	9.1	1.08
.34	1.68	0.17	1.68	0.17	1.68	0.17	1.68	0.17	1.68	0.17	23.49	2.89
.03	0.17	0.01	0.17	0.02	0.17	0.02	0.17	0.02	0.17	0.01	1.87	0.22
.24	1.2	0.12	1.2	0.12	1.2	0.12	1.2	0.12	1.2	0.12	16.8	2.04
1.77	8.83	0.87	8.83	0.88	8.83	0.88	8.83	0.88	8.83	0.87	123.05	14.96
0	4.14	0.41	4.14	0.21	4.14	0.21	4.14	0.21	4.14	0.41	49.68	8.28
.44	0	0	2.18	0.11	0	0	2.18	0.11	0	0	10.9	1.74
.12	0.61	0.09	0	0	0	0	0.61	0.15	0.61	0.06	14.05	1.18
.56	4.75	0.5	6.32	0.32	4.14	0.21	6.93	0.47	4.75	0.47	74.63	11.2
.03	0	0	0.33	0.03	0	0	0.33	0.07	0.33	0.02	2.64	0.39
.27	1.33	0.2	0	0	0	0	1.33	0.33	1.33	0.13	30.63	2.6
.03	0	0	0.25	0.03	0	0	0.25	0.05	0.25	0.01	2.0	0.3
.17	0.83	0.12	0	0	0	0	0.83	0.21	0.83	0.08	19.13	1.63
.06	0	0	0.29	0.01	0	0	0.29	0.01	0	0	1.45	0.22
0	1.08	0.27	1.08	0.11	1.08	0.65	1.08	0.87	1.08	0.32	25.95	8.65
.07	0.67	0.1	0	0	0.33	0.3	0	0	0.33	0.02	4.65	1.53
.63	3.91	0.69	1.95	0.18	1.41	0.95	4.11	1.54	4.15	0.58	86.45	15.32
.55	2.74	0.27	2.74	0.27	2.74	0.27	2.74	0.27	2.74	0.27	38.39	4.65
.7	3.48	0.35	3.48	0.35	3.48	0.35	3.48	0.35	3.48	0.35	48.72	5.95
.32	1.6	0.08	1.6	0.16	1.6	0.16	1.6	0.16	1.6	0.08	17.6	1.92
.55	2.76	0.28	2.76	0.28	2.76	0.28	2.76	0.28	2.76	0.28	38.61	4.7
.64	3.19	0.32	3.19	0.32	3.19	0.32	3.19	0.32	3.19	0.32	44.66	5.44
.76	13.77	1.3	13.77	1.38	13.77	1.38	13.77	1.38	13.77	1.3	187.98	22.66
.15	246.22	27.82	168.1	18.28	236.78	27.72	286.12	35.86	230.53	17.27	3626.33	547.72

flow and intake rates indicated that there are approximately 1.9 million people involved in water pollution control activities in manufacturing industries; whereas, the average number of employees models indicated approximately 1.0 million. The difference is not as large if a correction is made to include estimates for the omitted tobacco, furniture, leather and miscellaneous manufactures, but with this correction the estimate based upon average employment is only 1.15 million. Without some base for comparison, it is impossible to say that either estimate is superior to the other.

A comparison of the projections based upon average employment (EPA Survey) with those obtained with the ESSC models (Table 26) indicates that the EPA estimates are probably very conservative. The ESSC projections indicate that over 3.7 million people are involved in water pollution control with 0.57 million full-time-equivalent employees. This represents an employment figure of over three times that predicted by the EPA average employment models.

When the mean water intake rates for process use were subdivided according to individual industries within a major industry group, little change occurred in the total number of employees required by industry. However, within particular major groups the projected manpower requirements differed greatly. The difference was directly proportional to the deviation in water use within subdivisions from the mean for the major industry group. Manpower needs should be directly related to the discharge rate of a wastewater treatment facility; therefore, it appears reasonable to assume that the results based upon discharge, or process water use, are the best estimates of the manpower involved in water pollution control in the manufacturing industries.

Other Studies

Gilbertson and Collins (1971) conducted a survey to determine the present (1971) and projected manpower requirements of manufacturing industries in Pennsylvania. It was found that only 18 percent of the industries responding (Table 28) had environmental control programs. This 18 percent employed 3,295 people in environmental control activities and openings for 703 others existed. Assuming that the remaining 80 percent of the industries will eventually require the same level of manpower engaged in pollution control, a tremendous increase in manpower needs will occur in Pennsylvania when new standards are enforced. The distribution of the types of pollution control personnel employed and needed in Pennsylvania industries is shown in Table 29. Additional manpower is needed in all areas of activity.

Kessel (1973) conducted a similar study in the Environmental Protection Agency Region I and concluded that only a few private facilities in New England are treating their wastes. The sample represented approximately 4 percent of all known facilities, but was chosen selectively to reach firms with treatment plants. Only 37 percent of the firms in the sample were treating wastes. This indicates that a very small

Table 28. Environmental manpower employed by industrial category in manufacturing industri

SIC Code	Number of Replies	Env. Control Programs				Programs Ope		
		Yes		No	Not Stated	In-House Staff		Consult Service
		Number	%	Number		Number	%	
19 Ord. & Acces.	30	11	37	19	0	3	27	2
20 Food & Kindred	1,130	240	21	889	1	99	41	47
21 Tobacco Mfr.	31	5	16	26	0	4	80	0
22 Tex. Mill Prod.	357	52	15	304	1	24	46	15
23 Apprl. & Rel. Prod.	872	37	4	835	0	17	46	9
24 Lum. & Wood Prod.	480	59	12	421	0	31	53	9
25 Fur. & Fixtures	281	38	14	243	0	24	63	5
26 Paper & Alld. Prod.	240	72	30	168	0	40	56	9
27 Print. Pub. & Alld. Prod.	1,087	49	5	1,038	0	24	49	12
28 Chem. & Alld. Prod.	374	186	50	188	0	117	63	10
29 Pet. Rfng. & Rel. Ind.	94	56	60	38	0	22	39	14
30 Rub. & Misc. Plastics Prod.	209	47	22	162	0	26	55	
31 Lthr. & Lthr. Prod.	95	14	15	81	0	7	50	
32 Sto. Clay. Gls. & Conc. Prod.	607	179	29	428	0	74	41	3
33 Prim. Met. Ind.	349	164	47	184	1	61	37	4
34 Fab. Met. Prod.	1,049	187	18	862	0	96	51	3
35 Mch. Except Elec.	1,161	138	12	1,022	1	91	66	1
36 Elec. Mch., Equip. & Sup.	377	99	26	278	0	52	53	
37 Trans. Equip.	180	42	23	138	0	21	50	
38 Inst. & Rel. Prod.	169	29	17	140	0	19	66	
39 Misc. Mfg.	263	29	11	233	1	24	83	
40 Unk. S.I.C.	30	5	17	24	1	2	40	
Totals	9,465	1,738	18	7,721	6	878	51	2

gory in manufacturing industries in Pennsylvania (Gilbertson and Collins, 1971).

s	Programs Operated By					Number Employed	Est. Need	Increase, %
Not tated	In-House Staff		Consultant Services	Both	Not Stated			
	Number	%						
0	3	27	2	6	0	29	7	24.1
1	99	41	47	55	39	471	87	18.5
0	4	80	0	1	0	5	1	20.0
1	24	46	15	9	4	62	2	3.2
0	17	46	9	1	10	19	1	5.3
0	31	53	9	5	14	62	17	27.4
0	24	63	5	5	4	24	1	4.2
0	40	56	9	20	3	207	67	32.4
0	24	49	12	3	10	43	10	23.3
0	117	63	10	48	11	603	129	21.4
0	22	39	14	15	5	69	15	21.7
0	26	55	6	11	4	102	2	2.0
0	7	50	1	3	3	12	2	16.7
0	74	41	34	59	12	334	94	28.1
1	61	37	45	50	8	401	95	23.7
0	96	51	30	32	29	218	52	23.9
1	91	66	18	19	10	203	40	19.7
0	52	53	9	26	12	221	31	14.0
0	21	50	4	15	2	89	27	30.3
0	19	66	0	5	5	51	17	33.3
1	24	83	1	3	1	51	2	3.9
1	2	40	0	2	1	19	4	21.1
6	878	51	280	393	187	3,295	703	21.3

Table 29. Environmental manpower employed in various occupational categories in manufacturing industries in Pennsylvania (Gilbertson and Collins, 1971).

	Number Employed	Percentage of Number Employed, %	Estimated Need	Increase, %
Sanitary Engineer	169	5.1	21	12.4
Water Supply Engineer	69	2.1	10	14.5
Wastewater Treatment Engineer	223	6.8	37	16.6
Air Pollution Control Engineer	248	7.5	65	26.2
Solid Waste Disposal Engineer	102	3.1	46	45.1
Radiological Protection Engineer	30	.9	2	6.7
Hydraulic Engineer	27	.8	2	7.4
Other Engineer	628	19.1	120	19.1
Bacteriologist Scientist	43	1.3	9	20.1
Biologist Scientist	22	.7	7	31.8
Chemist Scientist	489	14.8	69	14.1
Industrial Hygienist Scientist	60	1.8	14	23.3
Other Scientists	30	.9	5	16.7
Air Pollution Technician	116	3.5	64	55.2
Hydraulic Technician	15	.5	2	13.3
Industrial Waste Technician	148	4.5	52	35.1
Sanitarian Technician	94	2.9	19	20.2
Solid Waste Technician	53	1.6	17	32.1
Wastewater Treatment Plant Tech.	244	7.4	52	21.3
Water and Wastewater System Tech.	132	4.0	35	26.6
Water Treatment Plant Technician	88	2.7	7	8.0
Other Technician	247	7.5	33	13.4
Unknown Profession	17	.5	15	88.2
Total	3,295	100.0	703	21.3

percent of the total number of firms are treating wastes. The percentage treating wastes would probably be roughly equivalent to the percentage treating wastes in Pennsylvania. Again, when new standards are enforced, a significant increase in the number of personnel employed in pollution control will occur.

This anticipated large influx of people to the environmental control field will place a tremendous demand on the existing training activities. It is critical that plans be made now to develop and implement professional, technical, and operatoral training and updating programs. If this training need is not recognized and implemented prior to the enforcement, the first impact of the consequences will be felt by municipal treatment facilities. Industry pays operators and technicians much better salaries than municipalities, and industry will hire experienced operators currently employed by municipalities. This will result in a further degradation in the quality of personnel operating public facilities and deprive the public of the benefit that should result from having paid for the operators training. If this does, in fact, occur, and the quality of operators available to municipalities is declining at the same time as we are constructing major new and complex plants, it is obvious that there will be significant problems in the performance of those plants. EPA should exert substantial effort to insure that these are well operated and that the total pool of operator capability is adequate for municipal needs.

Coplon and Smith have reported growth in environmental pollution control employment which closely approximates that shown by Gilbertson and Collins (1971), Middlebrooks (1972), and Kessel (1973). Results of the study are summarized in Table 30.

Table 30. Comparison of sample survey EPC employment totals with estimated national net growth.

Type of Employer	Total 1972 EPC Base		Total 1973-1975 Anticipated EPC Net Growth			
			From Sample		From National Estimate	
	For Sample	From National Estimate	No.	% Increase	No.	% Increase
Federal	11,274	NA[a]	1,291	11	1,291[a]	11[a]
State	2,471	5,440	1,249	51	3,979	73
City	2,563	11,139	947	37	7,034	63
Industry (Total)	1,121	14,717	521	46	NA[a]	NA[a]
(Manufacturing Only)[b]	426	11,861	312	73	4,355	37

[a] No national estimates made.

[b] Manufacturing industry only.

CHAPTER V

EVALUATION AND CONCLUSIONS

Projections showing the manpower requirements for water pollution control when all industrial dischargers have provided the equivalent of secondary treatment are the most current and accurate estimates available, and it is felt that these estimates are reasonable. Accurate estimates of the current manpower being utilized in water pollution control activities in the various industry groups are very difficult to make using the data collected in this study. However, a reasonable range of people employed can be estimated by employing the results of other studies.

Based upon studies by Gilbertson and Collins (1971) and Kessell (1973), it is obvious that substantial growth in manpower employed in industrial water pollution control will occur over the next five years. They have shown that less than 10 percent of all the wastewater dischargers in Pennsylvania and the New England areas utilize any type of wastewater treatment prior to discharge. Further support of their conclusions was obtained by examining the 1968 census data which showed the volumes of wastewater receiving treatment prior to discharge. By assuming that only the wastewater receiving trickling filter and activated sludge treatment will satisfy current discharge standards, in 1968 only 4.8 percent of the establishments reporting were producing a satisfactory effluent. This is probably a liberal estimate of the industries providing adequate treatment when it is considered that plants providing some form of treatment would be more inclined to respond to the census. Utilizing these estimates, it appears that the current manpower involved with water pollution control in the manufacturing industries ranges between 15 and 25 percent of the estimated saturated work force of 3.6 million, or from 540,000 to 900,000 people.

The above observations and results indicate an upward trend in employment in the manufacturing industries in water pollution control, and a reasonable estimate of the increase over the current level of employment ranges between 300 to 400 percent over the next five years. The rate at which an increase in work force will occur is directly related to rate at which enforcement procedures are implemented.

Whether the linear relationships obtained between the manpower requirements and the wastewater discharge rate in the EPA survey will hold at higher discharge rates is unknown, but when compared with the results of the ESSC study it appears that too little data for large plants was available. This would lead to the conclusion that the ESSC models are probably more realistic and should be used to make projections. Results of projections made with the ESSC models are two to three times larger than those obtained with the EPA models which at first seems excessive. But, consideration of the fact that there are approximately 250,000 industries discharging wastewaters in the United States, shows that a figure of approximately 3.5 million people involved in pollution control is not unrealistic if new standards are implemented and enforced.

The majority of the personnel employed in water pollution control activities in the manufacturing industries will be involved in treatment plant operation and control. Larger industries will probably employ specialists in wastewater processing operation and control and design groups at the corporate level to assist in the control of pollution. Even at the corporate level, only a few of the environmental specialists being produced by the colleges and universities will be employed. This is attributable to the feeling in industry that it is easier to train a man familiar with the industry to process wastewater than it is to familiarize an environmental specialist with the industrial process.

Wastewater process control techniques and operators will probably be in greatest demand by industry as new standards are enforced. This need will be met partially by upgrading existing plant personnel, but there should be a significant increase in the number of technicians and operators hired directly. Initially, many of these individuals will be produced by intensive training through continuing educational programs or specialized short courses.

The need for intensive type educational and training activities will be further accentuated as wastewater treatment plants become more automated. It is likely that automation will reduce the total number of personnel employed in wastewater treatment plants, but automation will certainly necessitate the use of more skilled operators and technicians to calibrate and control the facilities. Advanced treatment concepts and automatic control are being advocated as the panacea of wastewater treatment; however, so often the additional skills and levels of competence required of the operators and supervisory personnel are overlooked or dismissed as inconsequential. If these advanced concepts are to serve a useful purpose in the fight against water pollution, it is essential that proper care and thought go into planning the training and educational activities that will provide the manpower for the future.

The acceptance of operators and technicians well trained in the operation and monitoring of wastewater treatment plants will also be affected by trade union activities. Therefore, all training activities oriented toward operators and technicians must be coordinated with management and the trade unions if successful programs are to be developed.

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APPENDIX A

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ENVIRONMENTAL PROTECTION AGENCY

Office of Water Programs

Report of Industrial Wastewater Discharges

NOTICE

Please read carefully the instructions and notes below before attempting to complete this report.

a. If your facility has filed or will be filing an application with the U.S. Army Corps of Engineers for a permit to discharge into navigable waters, completion of this form should be governed by the following:

1. Where there is no discharge other than to navigable waters and there are no personnel or facilities for treatment of wastewater prior to discharge: complete Items 1 through 5, 8 and 9 of Section I and return the report with a statement to that effect.
2. Where there is no discharge other than to navigable waters but wastewater treatment is provided before discharge: complete Items 1 through 5, 8 and 9 of Section I and a full Section III.
3. Where there are discharges other than to navigable waters, e.g. to municipal facilities, surface containments, etc.: complete Items 1 through 5, 8 and 9 of Section I, a Section II for each discharge other than those to navigable waters and a full Section III where treatment of wastewater before discharge is involved.

b. If your facility is not required to obtain a Corps of Engineers discharge permit, complete Section I, disregarding Items 6, 7, 10 and 11. Complete a Section II for each discharge and a Section III where treatment of wastewater before discharge is involved.

c. All information contained in this report will, upon request, be made available to the public for inspection and copying. Confidential treatment may be extended to specific information which the reporting company considers to constitute trade secrets or commercial or financial information of a confidential nature. Such information must be reported on a separate sheet entitled "Confidential Answers" and must clearly indicate the item to which it applies. Confidentiality will be extended if the reporting company can clearly demonstrate to the satisfaction of the Administrator of the Environmental Protection Agency or his authorized representative that the disclosure of such information to the general public would divulge methods or processes entitled to protection as trade secrets or would reveal commercial or financial information of a confidential nature. In no event will identification of the contents and frequency of a discharge be recognized as confidential or privileged information.

d. Submission of information requested on this form is voluntary.

e. Indicate type of report by circling either a.1., a.2., a.3., or b. above.

SECTION I. GENERAL INFORMATION

1 State (standard abbreviation) ____ ____

U.S. Army Corps of Engineers Application No. ____ Div. ____ Dist. ____ Type ____ Seq. No. ____

Code No. (to be assigned by EPA) ______________

2 Name of reporting company, agency or other organization

____

3. Mailing address of reporting company, agency or other organization

____

____

____

____

4. Name, telephone number, title and mailing address of authorized agent for coordination and correspondence regarding this report

Name ______________________________ Telephone Number ____________

Title ______________________________

Mailing Address ______________________________

____

Signature and title of principal officer responsible for completing and forwarding this report

______________________________ ______________________________
Signature Title

EPA Form 7500-1 (7-71)

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5. Date

___ ___ ___ mo ___ ___ day ___ ___ yr

(Office use only)

6. [illegible] [illegible] ☐ [illegible] ☐

7. [illegible]

8. Name of plant where discharge will occur

9. Full mailing address of plant named in item 8 above

10. [illegible]

11. [illegible] [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible] ☐

12. If activity is temporary in nature, estimate its duration in months

13. List intake sources

Source	Estimated Volume in Million Gallons Per day or Fraction Thereof
Municipal or private water supply system	___ ___ ___ ___.___ ___
Surface water body	___ ___ ___ ___.___ ___
Ground water	___ ___ ___ ___.___ ___
Other	___ ___ ___ ___.___ ___

14. Describe water usage within the plant

Type	Estimated Volume in Million Gallons Per day or Fraction Thereof
Cooling water	___ ___ ___ ___.___ ___
Boiler feed water	___ ___ ___ ___.___ ___
Process water	___ ___ ___ ___.___ ___
Sanitary system*	___ ___ ___ ___.___ ___
Other	___ ___ ___ ___.___ ___

15. List volume of discharges or losses other than into navigable waters

Type	Estimated Volume in Million Gallons Per day or Fraction Thereof
Municipal waste treatment system	___ ___ ___ ___.___ ___
Surface containment	___ ___ ___ ___.___ ___
Underground disposal	___ ___ ___ ___.___ ___
Waste acceptance firms	___ ___ ___ ___.___ ___
Evaporation	___ ___ ___ ___.___ ___
Consumption	___ ___ ___ ___.___ ___

* Indicate number employees served per day ____________

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SECTION II. PLANT PROCESS AND DISCHARGE DESCRIPTION

1. Discharge described below is
a. Present ☐ b. Proposed new or changed ☐

2. Implementation schedule ☐

(Office use only)

Name of corporate boundaries within which the point of discharge is located

State 3. ______

County 4. ______

City or Town 5. ______

6. Discharge Serial No.

State the precise location of the point of discharge

7. Latitude ___ ___ Degrees; ___ ___ Min; ___ ___ Sec.

8. Longitude ___ ___ ___ Degrees; ___ ___ Min; ___ ___ Sec.

9. Name of waterway or other point of discharge

10. Has application for water quality certification or description of impact been made? If so, give date:

Date __ __ mo __ __ day __ __ yr

Check if certificate is attached to form ☐

Name Issuing Agency ______

11. Narrative description of activity (include terms of general 4-digit Standard Industrial Classification, and specific manufacturing process)

12. Standard Industrial Classification Code number

13. Principal products

14. Amount of principal products produced per day

15. Principal raw materials

16. Amount of principal raw materials consumed per day

17. Number of batch discharges per day

18. Average gallons per batch discharge

19. Date discharge began __ __ mo __ __ day __ __ yr

20. Date discharge will begin __ __ mo __ __ day __ __ yr

21. Describe waste abatement practices

EPA Form 7500-1 (7-71)

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22. PHYSICAL DESCRIPTION OF INTAKE WATER AND DISCHARGE	
Discharge Serial No.	(Office use only)

Parameter and Code	Intake		Discharge				
	UNTREATED INTAKE WATER (1)	TREATED INTAKE WATER (2)	AVERAGE (DAILY) (3)	MINIMUM (OPERATING YEAR) (4)	MAXIMUM (OPERATING YEAR) (5)	SAMPLE FREQUENCY (6)	CONTINUOUS MONITORING (7)
Flow (Gallons per day) 00056							
pH 00400							
Temperature (Winter) (°F) 74028							
Temperature (Summer) (°F) 74027							

23. **DISCHARGE CONTENTS**

PARAMETER	PRESENT	ABSENT	PARAMETER	PRESENT	ABSENT	PARAMETER	PRESENT	ABSENT
Color 00080			Aluminum 01105			Nickel 01067		
Turbidity 00070			Antimony 01097			Selenium 01147		
Radioactivity 74050			Arsenic 01002			Silver 01077		
Hardness 00900			Beryllium 01012			Potassium 00937		
Solids 00500			Barium 01007			Sodium 00929		
Ammonia 00610			Boron 01022			Titanium 01152		
Organic Nitrogen 00605			Cadmium 01027			Tin 01102		
Nitrate 00620			Calcium 00916			Zinc 01092		
Nitrite 00615			Cobalt 01037			Algicides 74051		
Phosphorus 00665			Chromium 01034			Oil and Grease 00550		
Sulfate 00945			Copper 01042			Phenols 32730		
Sulfide 00745			Iron 01045			Surfactants 38260		
Sulfite 00740			Lead 01051			Chlorinated Hydrocarbons 74052		
Bromide 71870			Magnesium 00927			Pesticides 74053		
Chloride 00940			Manganese 01055			Fecal Streptococci Bacteria 74054		
Cyanide 00720			Mercury 71900			Coliform Bacteria 74056		
Fluoride 00951			Molybdenum 01062					

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SECTION III. WASTE TREATMENT FACILITIES COST AND MANPOWER INFORMATION

(Office use only)

1. Give approximate expenditures (in thousands of dollars) for existing and future wastewater treatment facilities and/or in-plant control processes. (See instructions)

Original Facility - Type	Year Placed in Operation	Original Cost
Facility Addition 1 - Type	Year Placed in Operation	1st Addition Cost
Facility Addition 2 - Type	Year Placed in Operation	2nd Addition Cost
Facility Addition 3 - Type	Year Placed in Operation	3rd Addition Cost
Facilities to be Constructed this Year	This Year	This Year's Expenditures
Facilities to be Constructed Next Year - Type	Next Year	Next Year's Expenditures
Facilities to be Constructed Next Year + 1 - Type	Next Year + 1	Next Year + 1 Expenditures
Facilities to be Constructed Next Year + 2 - Type	Next Year + 2	Next Year + 2 Expenditures
Facilities to be Constructed Next Year + 3 - Type	Next Year + 3	Next Year + 3 Expenditures
Facilities to be Constructed Next Year + 4 - Type	Next Year + 4	Next Year + 4 Expenditures

2. List expenditures (in thousands of dollars) for the operation and maintenance of your facility. (See instructions for calculation of operation and maintenance expenditures)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	Past Year	Present Year	Next Year	Next Year + 1	Next Year + 2	Next Year + 3	Next Year + 4
Expenditures							

3. Remarks

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4. For each of the categories below, list the current number of employees (full time/part time) doing water pollution control work and estimate the total number of employees for each of the next five calendar years. (See Instructions)

	Number Full Time Currently Employed (1)	Number Part Time Currently Employed (2)	Total Number Next Year (3)	Total Number Next Year + 1 (4)	Total Number Next Year + 2 (5)	Total Number Next Year + 3 (6)	Total Number Next Year + 4 (7)
Superintendent							
Engineer/San. Engineer							
Chemist							
Biologist							
Lab. Technician							
Senior Operator/ Foreman							
Equipment Operator							
Instrument Repairman							
Maintenance Man							
Attendant							
Unskilled							
Clerical							
Others (Specify)							
Others (Specify)							
Others (Specify)							

5. Remarks